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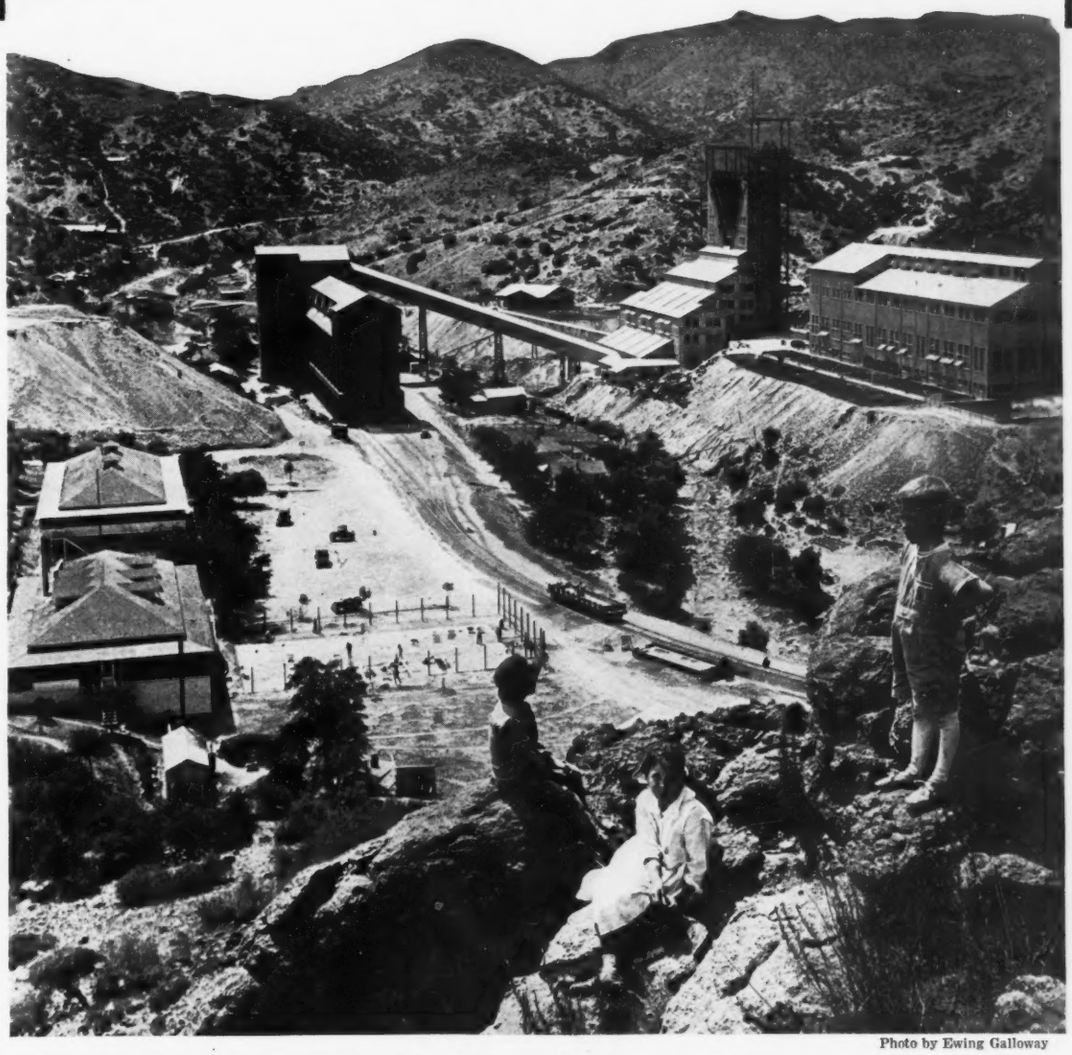

Photo by Ewing Galloway

Earning Power of Capital in Copper Industry of Western Hemisphere
By Arthur Notman

Improvements in Zinc Milling in Tri-State District
By H. H. Wallower

Electrical Equipment at Rosario Mill and Mine
By Frederick Krug

A WEEKLY JOURNAL REPRESENTING THE WORLD'S MINING AND METAL INDUSTRIES

June 30, 1923

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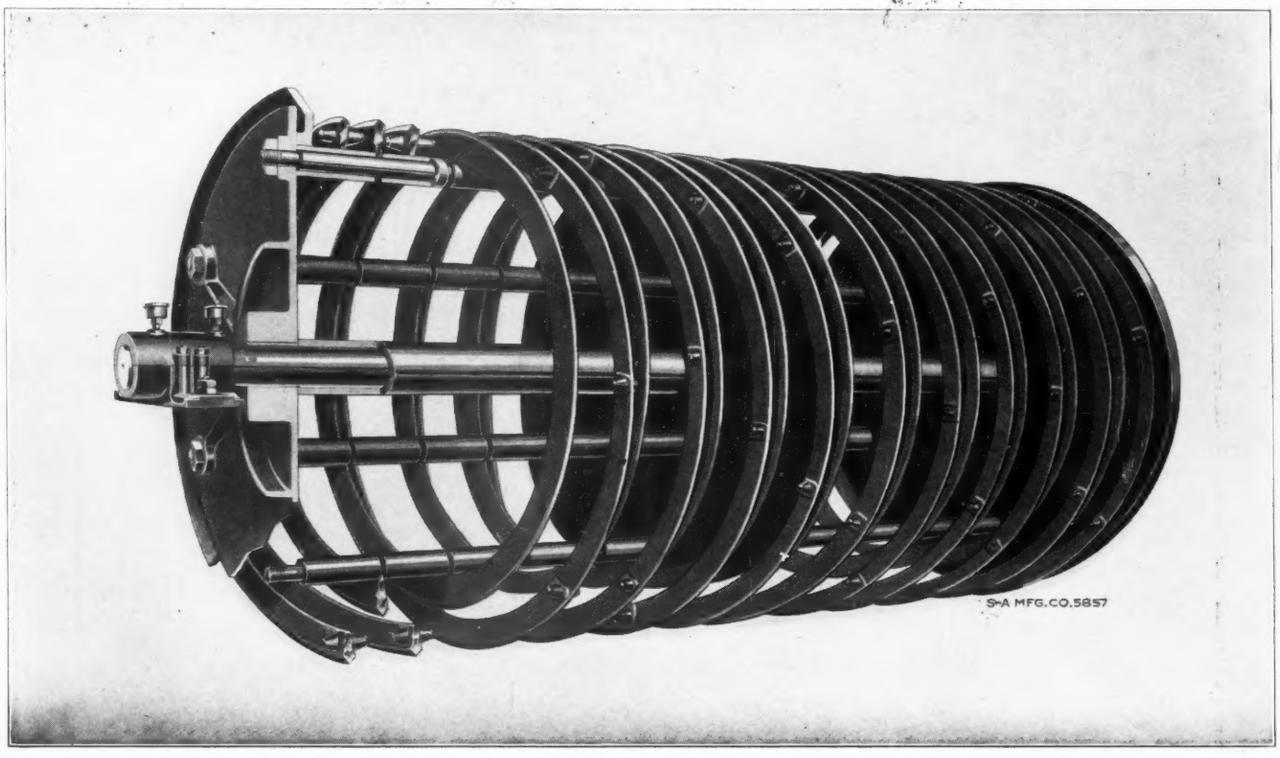

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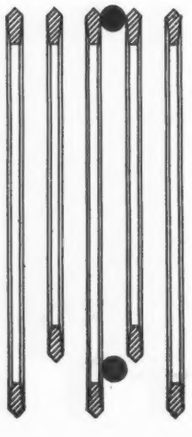

A Ring Type Grizzly That Will Not Clog

The over-size is carried over on top the rings. The fines pass thru.

Where fines are to be separated from the product that goes to the crusher, the Burch Grizzly is right in its element. The Grizzly will carry over the lumps to the crusher and allow the fines to be by-passed.

This Grizzly was invented by H. Kenyon Burch, prominent Mining Engineer.

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ENGINEERING & MINING
JOURNAL-PRESS
JOSIAH EDWARD SPURR, Editor

Volume 115 | New York, June 30, 1923 | *Number* 26

An Experiment Fails

THE PUBLIC is often the principal sufferer in the case of strikes and lockouts. This fact has led many to look with favorable eyes upon the experiment made in Kansas with the State Industrial Court, created for compulsory arbitration of such disputes. The Industrial Act creating the court was based upon the fact that all industry is affected with a public interest and that disputes between capital and labor should be subordinated to it. The act can hardly be said to have been popular except with those that consider themselves neither labor nor capital. The organized workman has looked upon it as depriving him of the principal advantage that his organization afforded, and on the other side capital has regarded it as another case of too much government in business and as an unjustified interference with its rights.

Whatever be its merits, the experiment has been interesting and it is to be regretted if it cannot be continued longer. For it seems about to end. The unanimous opinion of the U. S. Supreme Court, handed down on June 11 and stating that the tribunal was without power to fix wages in the plant of a certain packing company, makes the court practically useless. On the findings of the Industrial Court, stated Chief Justice Taft, owners and employers were to be deprived of freedom of contract and workers of a most important element of their freedom of labor. Thus the court is shorn of its power. Governor Davis is said to be considering asking the Legislature to abolish it.

But the fact remains that the rights of the public are often ignored when capital and labor disagree. And it is also true that the public is coming to resent such occurrences. Other experiments like that in Kansas will be necessary until the problem is satisfactorily solved.

All Reserve Stocks of Copper Finally Sold

SURPLUS STOCKS of large proportions have been the bugbear of the copper industry for the last four years; or possibly they should be characterized by a different term, for, according to the dictionary, a bugbear is something imaginary, and the stocks have been very real indeed, as any one who has been around the smelters and refineries knows. In the last year, to be sure, no one has worried about them much, for they were rapidly being depleted, and it was evident that they were no longer a depressing factor. For some months the refinery stocks available for domestic sale have been no larger than normal, and the stocks of brass scrap, a heritage from the World War, have been virtually exhausted. Last week came the news that the 400,000,000 lb. earmarked for export through the Copper Export Association in 1921 had all been sold. It is also reported that the available European war stocks of copper and brass have all been consumed, which is evident from the fact that practically every country is again buying virgin metal.

So now the slate is at last clean, and for every pound of copper sold a pound must be produced. The amount of copper that has been taken from the stocks of the Copper Export Association has averaged, until the recent slump, about 15,000 tons per month. This must now come out of current production, and it is likely that the demand will gradually increase as the European countries get on their feet, now that there are no other sources of the metal. To prevent a shortage, either production must be further increased or less copper must be used. The first-mentioned alternative will, in all probability, soon take place; some of the larger companies will work nearer to capacity. Later on, if and when there is less industrial activity in the country, domestic consumption may taper off somewhat. This may, however, be offset by an increased foreign demand.

All in all, the copper industry has reason to expect a period of great activity over the next two or three years. But markedly higher prices, considering the immense capacity of the low-cost producers, seem unlikely to be realized.

Gold Dredging in California

WHEN WILL GOLD DREDGING be a thing of the past in California? was a question asked at a recent meeting of the gold-dredge operators in Grass Valley, Calif. The result of answers to this question by operators who are familiar with the dredgeable areas still remaining was that gold dredging will be practically finished in California within ten or twelve years.

The first successful gold dredge in California was started March 1, 1898, according to Charles Janin. The dredging industry has thus been in existence for twenty-five years and will have had a life of about thirty-seven years when the present dredging areas are exhausted. The maximum number of dredges in operation at any one time was in 1910, when seventy-two dredges produced $7,550,254. The number in operation at present is twenty-four, and the rate of production is in excess of that made in 1910.

The industry has been uniformly prosperous except during a part of the war period. This condition has been due to a liberal spirit in the interchange of information and a steady development of the dredge itself. There have been few changes or improvements in principle, but steady progress has been made in improved design and construction. Most of the vital parts of the gold dredge have been standardized.

The practice of gold dredging and tin dredging, which follow similar lines, has been developed to the point that, given an area of probable importance, the facilities for working and experienced working crews can be assembled and the property put in operation. This condition is due to the dredger men of California. Ex-

perienced men now go forth to Alaska, Tasmania, the Federated Malay States, South America and Siberia, and ply the vocation that they learned in California. The initiative and pluck of these men are at the service of the world, and they and their kind may be relied upon, even though the industry becomes extinct in the place where it flourished, to carry on until the last acre of dredgeable ground has been worked. We have no fear that dredging will not be an important kind of mining practice twenty years hence, or even fifty years from now. Unfortunately, it is true that both the metal miner and the gold dredger must go on to new areas when they have worked out the old, but the world is the miners' field and improved transportation facilities are constantly bringing new districts to his attention.

Back to the Days of Barter

THE EDITORS of country newspapers are supposed to receive a couple of bushels of potatoes, three or four pounds of butter, or a load of hay in return for a subscription or local advertisement, or at least this method of barter held true to a certain extent not so very long ago. It is not customary for a magazine like the *Journal-Press*, however, to be paid similarly in goods. Yet, conditions have come to such a pass in Germany that we have received the following offer:

Dear Sirs,

We beg to give you the order for publishing the text of the advertisement stadet on the annexed card. With regard to the econimical and financial conditions of Germany we trust it will be preferable for you too, to receive the compensation for the publication of the advertisement noted on the other page, in goods and not in German Marks. It is for that reason that we beg you kindly to choose in the annexed offer such articles, you will be pleased with, for the total summ corresponding to the price for printing one or several publications. The articles you will choose will be forwarded you without any expenses, postage paid, as soon as we will be in possession of the authoritative copies.

All the editors of other countries have with pleasure agreed with that kind of compensation, the more so, as the first class quality of the articles we delivered have everywhere been much appreciated.

We have several articles to choose from as our recompense for the proffered advertising. Among them are:

A) **Photographer's apparatus** will full equipment as copying-frame, Ph. plates, developer, paper, toning-fixing-bath and so on. $ 1.

B) **Type-writing-machine,** solid fine and exceedingly convenient Model. $ 2.

C) **Calculating machine,** for the pocket and for the office with fashionable case, calculates in an entirely sure, quick and absolutely reliable way the most important kinds of calculation. A wonder of precision mechanics. Every calculator is glad and charmed! $ 2.

D) **Telescope,** most elegant execution, best optics, including a solid case. $ 1.

E) **Domestic Kinematograph,** Most charming novelty! Highly interesting, for amusement and for instruction. $ 2.

This sounds humorous, but the conditions are in many respects pathetic. With the German mark worth less now than 100,000 for a dollar, there must soon come a real financial crisis when the paper mark will become valueless. Possibly the change will come as it did in Mexico a few years ago, when paper money disappeared as a medium of exchange overnight and was superseded by a metallic currency.

Stable conditions in Germany are of real interest to Americans, particularly to the American mining industries, for Germany is normally one of our best customers.

Judge Gary and Twelve Hours a Day

WE DO NOT BELIEVE that many people believe that Judge Gary believes his own statement that the twelve-hour day in the steel industry "has not of itself been an injury to the employees, physically, mentally, or morally." But assuming for the sake of the argument that he is sincere, we should like to have his views after the performance of the following imaginative experiment: Let there be prepared a good average nine-hole golf course, with the added equipment of adequate lighting arrangements to provide for playing during the night as well as during the day. Put the links in California where snow would not interfere and where the cold would not be excessive. Then set Judge Gary and the other members of the Steel Institute's committee at the task of playing golf twelve hours out of every twenty four, "swinging" each fortnight from the day to the night shift or vice versa. On "change" Sundays they would have a twenty-four hour stint, but this of course would be compensated for by a twenty-hour rest. Mr. Gary himself is getting along in years, so that the test might be unfair, but some of his younger confrères could no doubt stand the strain indefinitely. Two years would be enough. Let them get together again at the end of that time and prepare another report on the twelve-hour shift in industry. They would then be wiser men than they are today.

However, we are inclined to the opinion that ultimately the physical, mental, and moral welfare of the workers must be considered first instead of as secondary to the pecuniary welfare of the steel corporations and the stockholders whose money is invested in them. The United States Steel Corporation has spent many millions of dollars in welfare work in the communities in which it operates; it has spent other millions to promote safety in its plants; but for every dollar spent in this manner many dollars have accrued as profit to the corporation as a direct consequence of improved conditions in the industry. And these improved conditions can be traced directly to the welfare and safety work.

In practically every "continuous" industry in which the eight-hour day has been established it has been found, according to the Federated American Engineering Societies, that the quantity and quality of production has increased—in some instances as much as 25 per cent. Some day the officials of the United States Steel Corporation will be convinced that it can make steel more cheaply with an eight-hour shift on the work that is now being done by twelve-hour men; then the change will be made. Probably somebody with a different view of things than E. H. Gary will then be in control.

But even if the cost of steel be increased, which is at least debatable, the time will come when the Steel corporation will agree with the New York *Mail* when it says: "No man in America should have to work twelve hours a day in order to provide sufficient food, education, and good home conditions for his family. If he be forced to do that, forced to give every hour of his conscious life up to drudgery, wherein is he better than a slave? Such a man merely exists; he does not live. The industry that does not give a man a chance to develop spiritually, morally and even esthetically by paying him a wage which will allow him reasonable leisure has a mortgage on the man's soul, as well as on his body, the soul that should be active as a beneficially formative influence in the national life."

Bunk-house Gossip

THE WINK OF THE EYE, the whisper back of the palm of the hand, the furtive shrug of the shoulders, the uprolled eyes are signs of the professional gossip. These are the tricks of the trade, and all are designed to carry the inference that the bearer has tapped hidden but reliable information which, as a special favor to the recipient, is passed on for his private benefit. Bunk-house gossip is the source of messy news about the mining industry and individual mines in particular. Certain types of men snoop around the bunk house and gather it and spread it along its devious way. Bunk-house gossip is as old as mining. Sometimes there is a trace of truth in it; more often it is a libel against the mine or the men who are back of the mine. It is frequently used in stock-market manipulation as the source of tips which have for their purpose the undermining of confidence in a project or cloaking of a dubious project with the earmarks of merit.

Bunk-house gossip does harm to the mining industry. It would harm any industry or any individual who is a party to it or who may be the victim of it. The corrective for it is the opening up of the avenues to truthful information. By a liberal policy mining companies can render it innocuous. Reports should be given to the public at frequent intervals, and these should be accurate and candid. Annual reports that merely contain a statement of assets and liabilities are insufficient. Monthly and quarterly reports should be at least made available for publication. Companies privately owned and operated suffer from bunk-house gossip, as well as those whose stocks are bought and sold in the stock markets. They should not put obstacles in the path of those who seek to make public the details of mining operations. Their contention is that such matter is their own private information. Some of it is, no doubt, but they frequently overlook the fact that the mining community which grows up about their mine is vitally interested in its development. It may be proper to withhold certain information for private advantage, but there is much other information that could and should find expression in the publicity channels. Withholding it merely means that it will get out in garbled fashion and usually by the bunk-house route. Voluntarily giving it out in accurate statements pulls the teeth of the bunk-house artists.

Progress in Metric Standardization

EVIDENCE IN FAVOR of the urgent need for the abolition of the heterogeneous units of weights and measures that are used abroad may be found in the summary of mineral production in foreign countries, in 1919 and 1920, issued recently by the U. S. Geological Survey. The standardization of such data is essential, and, of course, the metric system is adopted by the Survey as providing the only practicable series of units for the purpose. A vast amount of work is involved in converting many of the foreign units. Factors are given by the Survey, by which one learns that the imperial gallon occupies 4.5436 liters, that the "picul" of the Dutch East Indies is 0.06168824 of a metric ton, that the cubic "shaku" of Japan is 0.02783 of a cubic meter, and the British hundredweight is 0.05080208 of a metric ton.

Thanks to the foresight of our ancestors, we conserve much energy that other nations are obliged to squander to figure monetary statistics in illogical units; we are saved the economic waste of having to calculate costs and expenditures in farthings, halfpennies, shillings, pounds, and guineas. What will our descendants think of us when the real reason is recalled, as it must be, for the opposition to the adoption of the metric system of weights and measures in the United States in the earlier decades of the twentieth century?

The chemical industries have shown a unified front in regard to the advisability of the adoption of the metric system in its entirety; the Mining and Metallurgical Society of America is in favor, also, according to the overwhelming majority of its members. May the time be not far distant when we can cease the illogical custom of borrowing a metric unit of money value to designate weight of precious metal in ore or bullion.

Bandit or Detective

BANDITRY has lost its terrors and kidnapping is no longer fraught with peril, since H. Watkinson, international sleuth, hung out his shingle, on Weedon Street, in Sheffield, England. For Mr. Watkinson will sally forth from Weedon Street, upon request, even to the wilds of Mexico, and the bold bandits will he bring in chains, even back to Weedon Street or whatever delivery point may be desired. Thus runs the saga of H. Watkinson, international sleuth, of Sheffield, England.

Juan Galindo, bold bandit of Durango, and his cohorts recently captured Oliver Krull, superintendent of some mines at San Diego, in Durango, asking no less than 10,000 pesos as the price of Krull's release. Mr. Krull, however, having an engagement elsewhere, up and left Señor Galindo in the night. Neither did he pay his lodging, much less the 10,000-peso ransom, which of course was very impolite, or so it seems.

Enter Detective Watkinson through the medium of a letter all the way from Weedon Street, in Sheffield, England. Writes Mr. Watkinson to Mr. Krull:

"It is with regret that I hear of you having to pay a ransome of $5,000 to some lawless outlaws. And I take this opportunity to offer you my services.

"I have a reliable party of assistants at my command and if you will forward a cheque, payable at the Bank of England, for £1,000, to cover the expenses of the party to go out there, I will forward a receipt by return.

"I assure you that you will never regret it and I guarantee that you will never be robbed again by these outlaws, as I will hand them over to justice either dead or alive. Having been in their hands, please try your best to answer me the following questions:

"1. Have you a photograph of a typical outlaw? If so, please send one, for me to copy the dress from.

"2. How many followers have the Outlaw Chiefts?

"3. How many Outlaw Chiefts are there, in the band of outlaws? [What knowledge of Mexico here displayed!]

"4. Who are they? Who is the ringleader?

"5. Who is the nearest police officer?

"If you will kindly answer these questions and any others you think likely to be of service, it will be unnecessary for me to call upon you when arriving in Mexico, until the roundup is finished. By following this method no suspicion will be roused and we can make right for the hills and have the matter settled."

Attesting this with thumbprints, Mr. Watkinson withdraws. Now let the bandits scatter and hie them for the woods; their days in truth are numbered. Brother Watkinson has the goods. At any rate, signs are that travel will now be safe south of the Rio Grande for anyone who has $5,000 for the bandits or £1,000 for Mr. Watkinson, recognition or no recognition.

Geologists of Note

J. MACKINTOSH BELL

By J. C. Murray

J. MACKINTOSH BELL was born remarkably few years ago, at St. Andrew's East, in Quebec. He comes of an old and not undistinguished Scottish family, a branch of which settled in Canada at a time when this country was a very dependent colony indeed. His boyhood and early manhood were spent in Almonte, a small and restful Ontario town, not far from Ottawa. Before he was legally entitled to vote, he was graduated (1899) as Master of Arts from Queen's University, at Kingston, having specialized in geology under the kindly eye of Prof. Willet G. Miller. In 1899 and 1900 he was the head of an expedition sent out by the Geological Survey of Canada to Great Bear and Great Slave lakes. The summers of 1901 and 1902 were devoted to geological reconnaissances and explorations for the Lake Superior Corporation; those of 1903 and 1904 to similar work for the Ontario Bureau of Mines. The winters of these years were spent at Harvard, from which university he received his Ph.D. in 1904, and where he also became "John Harvard" fellow and instructor in geology. Here Dr. Bell not only specialized in geology, but also took courses in mining and metallurgy. Quite characteristically he extracted the maximum of real profit from the curriculum of that ancient and urbane foundation. In 1905, he accepted the responsible position of Director of the Geological Survey of New Zealand. He resigned in 1911 to become consulting engineer to the London firm of Hamilton, Ehrlich & Turk. In the same year he had the honor to be elected president of the Australasian Institute of Mining Engineers. After some effective mining-geological work at the Spassky mine, Siberia, and on other properties, Dr. Bell induced his principals to turn their attention to Canada. Here, in 1912, he took his first bold step in getting hold of the Keeley silver mine, in the then abandoned region of South Lorrain. The latter history of the Keeley and of the district has amply vindicated his judgment. At the time he was the object of much adverse criticism.

J. MACKINTOSH BELL

Dr. Bell served throughout the war with distinction. He helped recruit the 73d Battalion Royal Highlanders of Canada, a regiment affiliated with the Black Watch, and served at the front in France until March, 1917, when he was invalided to England with trench fever. Later important missions took him to Russia and Siberia on two occasions on special intelligence work. He became attached to the General Staff of the British Military Mission to Siberia, under General Knox, and still later, on account of his intimate knowledge of the Russian language, was given charge of the Schools of Instruction for the commissioned and non-commissioned officers of Koltchak's new army. In recognition of his services he was awarded the decorations of the Military Order of the British Empire. In 1919, he returned to Canada and resumed, among other responsibilities, the direction of operations at the Keeley mine, the option on which had been exercised by his principals, the Associated Gold Mines of Western Australia. The spectacular rebirth of the Keeley is now history. Dr. Bell is at present consulting engineer for various interests, with his headquarters in Toronto. He is the representative in Canada of the British Institution of Mining and Metallurgy, and is a member of many other societies. Two books, "Wilds of Maoriland" and "Tales of the Red Children," are the most important of his literary offspring.

Dr. Bell's technical, linguistic and literary attainments are of a high order. Although circumstances have ordained that he should become, exteriorly at least, a cosmopolitan, he is intensely Canadian in sentiment and ideals. Paradoxically, though he may seem the "Admirable Crichton" of Canadian mining men, yet in the bush, where he is entirely at home, certain reprehensible colloquialisms flow from him with a gracile ease that is to be acquired only through trials and tribulations in the North Country. The qualities that go to make up the unusual composite of mining geologist, explorer, and business administrator he is fortunate enough to possess. The business sense that most mining engineers either lack or fail to develop is his precious Scottish inheritance.

Comparative Earning Power of Capital Invested in Copper Industry of Western Hemisphere

A Historical Study with an Analysis of the Results Obtained by Important Representative Producers in the United States, Canada, Mexico, Peru and Chile—The Outlook

By Arthur Notman
Consulting mining engineer and geologist, 170 Broadway, New York

THE FUTURE of any industry as vitally important to the progress of civilization as the production of copper has proved itself to be in the last century is a matter of capital interest to the general public. Perhaps no other human activity of equal importance was so completely demoralized by the Great War. At least no one connected with the business is prepared to admit the prior claim to public sympathy of any other industry. With this in mind, the time seems opportune to examine the history of the industry and in that light to endeavor to find answers to certain questions which have occurred to me to be pertinent to the future. I have listed these questions as follows:

1. Is the industry a permanent one?
2. What has been the yield to the public as an investor?
3. What is the amount of fixed capital per unit of production required by the industry?
4. What is the amount of working capital required?
5. What is the percentage of gross income paid in dividends by the industry?
6. What is the bearing of these questions on the future of the industry?

Nothing appears more certain, unless our civilization is indeed doomed, than the belief that the world will never use less of the products of mining than it is using at the present time. Naturally, by this statement, I do not mean time as measured by years, but rather as measured by decades. Every one will admit the truth of this as applied to coal, petroleum, and iron. But let us examine the growth of copper production in the world, to see whether or not the record accords with those of its more important associates. For our purpose, production figures will serve as well as those of consumption, in spite of the unmistakable overproduction at the close of the war. In the long run, the law of supply and demand balances production and consumption.

The following table shows the production of the United States and the world for the last 120 years:

Copper Production of the World and the United States by Decades Since 1801

In Tons of 2,240 Pounds

	United States Production	World Production
1801-1810	.....	91,000
1811-1820	.....	96,000
1821-1830	.....	135,000
1831-1840	.....	218,400
1841-1850	2,400	291,000
1851-1860	37,050	505,999
1861-1870	97,546	900,000
1871-1880	188,000	1,189,400
1881-1890	732,507	2,217,714
1891-1900	1,941,390	3,713,003
1901-1910	3,822,960	6,856,585
1911-1921	6,599,160	10,883,420

Statistics for the electrical industry and allied industry of communications by telephone and telegraph, and more recently by wireless, would show a similar phenomenal growth. The case of the automobile industry is too recent to need more than mention. These, with the building trades, are the principal consumers of copper.

We are accustomed to think of mining as a temporary industry in any particular locality. Natural caution dictates such an attitude of mind. We will not believe anything except that which we can see and measure with our engineer's tape. As yet we are unable to see very far into the ground. Much of this caution is a direct inheritance of the days when mining consisted largely in the search for bonanza bodies of the precious metals. It cannot be reconciled with the known reserves of bituminous coal and iron ore in the world, or even with such gold deposits as the Rand, the Homestake, the Alaska-Treadwell, or the more recent discoveries in eastern Canada.

From this point of view, what has been the history of the great copper districts of the world and does it support the idea that mining in them is a temporary affair?

The following table shows where 91 per cent of the copper production of the United States (approximately 45 per cent of that of the world) has come from up to date and the date at which production began in the various districts:

Blister Copper Produced in the Principal Districts of the United States to the End of 1921[a]

District	State	Began	Quantity, Lb.	Per Cent of Total
Butte	Montana	1868	8,015,008,000	27.00
Lake Superior	Michigan	1845	6,932,173,000	23.00
Bisbee	Arizona	1880	2,825,619,000	9.00
Bingham	Utah	1896	2,065,091,000	7.00
Globe-Miami	Arizona	1881	1,698,305,000	6.00
Morenci-Metcalf	Arizona	1873	1,514,097,000	5.00
Jerome	Arizona	1883	1,341,105,000	4.00
Ely (Robinson)	Nevada	1908	826,666,000	3.00
Santa Rita	New Mexico	1800	626,783,000	2.00
Ray (Mineral Creek)	Arizona	1911	585,447,000	2.00
Shasta County	California	1897	573,919,000	2.00
Ducktown	Tennessee	1850	398,553,000	1.00

(a) U. S. Geological Survey, Report of H. A. C. Jenison.

Only a few months ago, it was reported that in one of the oldest copper districts of the world, Rio Tinto, in Spain, where copper was mined in the days of the Romans, a new large lens had been discovered in hitherto unprospected ground.

The combined estimated reserves of copper recoverable by present methods of the porphyry companies in the United States on Jan. 1, 1922, stood in their annual reports at 18,000,000,000 lb. This amount is equal to the total production of the world for the seven years from 1912-1918 inclusive. The districts in which these reserves are located had produced up to that date 20 per cent of the total produced in the United States. The nature of these deposits is such that they lend themselves readily to estimation of reserves, and yet the history of these estimates shows a marked tendency to increase from year to year, in spite of the subtractions due to mining. In the last few years

several of these companies have altered their policies, and for the present at least show a disposition to avoid further expenditures for the proving of additional reserves. The Copper Queen property, in Bisbee, with which I have been familiar for the last fourteen years, has worked bodies of high-grade ore in limestone since 1880. Development work cannot be pushed far ahead of actual mining in such deposits. The estimated reserves of copper in them on Jan. 1 of this year were within 6 per cent of where they were on Jan. 1, 1913, while in the meantime the mine had produced about 800,000,000 lb. In addition, exploration in the granite porphyry of Sacramento Hill, begun in 1909, has developed disseminated ore estimated to provide tonnage for a 4,000-ton mill for the next eighteen years. Similar conditions no doubt prevail in regard to the Lake Superior and Butte deposits. If we should apply this same ratio to the other districts of the United States, we should be confronted with the staggering total of 90,000,000,000 lb. of recoverable copper.

Can we fail to be impressed with this evidence that copper districts do not play out? In fact, is there any record to show that any important copper district in the world has yet been exhausted? We must remember that, repeatedly, what has been unprofitable material in the past has eventually become ore with the improvements continually in progress in the arts of mining and metallurgy. Such improvements do not, as often thought, tend to increase the margin of profit in the industry, but, on the contrary, they bring into existence ever-growing reserves of leaner material, and so prolong the life of the deposits.

That the public as a whole has been shrewder than the engineers might be inferred from the evidence revealed by a study of the prices paid for copper stocks on the New York Stock Exchange, and the yield received therefrom by the public. Apparently they have sensed the strength of the factors tending toward permanency.

I have compiled below a table showing the average market price and yield of the principal dividend-paying copper stocks in the United States for the ten years ended Jan. 1, 1921:

Comparison of Yield on Average Market Prices of Copper Stocks

	1911–1915		1916–1920		1911–1920	
Company	Price	Rate, Per Cent	Price	Rate, Per Cent	Price	Rate, Per Cent
Ahmeek	$72.75	4.87	$82.00	10.48	$77.375	7.35
Allouez	40.25	6.39	49.00	11.22	44.625	6.39
Anaconda	41.875	9.79	68.375	9.38	55.125	9.52
Calumet & Arizona	63.25	5.16	69.375	10.67	66.375	8.51
Calumet & Hecla	467.00	6.77	448.00	10.27	457.50	8.48
Chino Copper	35.625	4.32	43.875	12.21	39.75	8.67
Copper Range	48.75	4.62	51.50	11.65	50.125	8.23
Greene Cananea	26.75	5.23	40.25	13.17	33.50	10.00
Inspiration	21.25	n.p.	52.25	11.01	36.75	8.97
Isle Royale	23.375	.86	29.00	8.62	26.125	5.17
Miami Copper	23.50	6.14	30.00	12.52	26.75	12.23
Mohawk	55.625	6.22	70.25	16.51	62.875	11.97
Nevada Consolidated	16.75	9.70	19.00	14.10	17.875	12.04
New Cornelia	.....	n.p.	17.875	.87	.....	.....
North Butte	28.625	5.10	17.50	6.86	23.00	5.84
Old Dominion	49.00	7.76	45.625	10.45	47.375	9.05
Osceola Consolidated	92.25	9.00	54.125	15.59	78.125	11.71
Phelps Dodge	216.75	7.15	264.75	8.87	240.75	8.08
Quincy	69.875	5.08	71.625	13.26	70.75	8.84
Ray Consolidated	18.00	3.24	23.375	11.35	20.625	7.85
Utah Copper	55.00	5.91	84.50	12.07	69.75	10.52
Wolverine	70.375	9.47	32.675	19.77	51.625	13.07

Total Group

Period	Average Value	Dividends	Yield, Per Cent
1911-1915	$615,292,302.00	$199,010,574.00	6.47
1916-1920	843,841,139.38	455,157,909.00	10.79
1911-1920	745,972,789.38	654,168,483.00	8.77

It is evident from the above that these stocks have been bought at prices yielding well below any such figure as the engineer would be inclined to recommend, and yet history fails to show anything to indicate that in the long run the public has suffered for its greater faith in the unseen, so long as it stuck to mines which produced both dividends and copper.

Mining Dividends Represent Both Capital and Profit

Before proceeding to study the third question, some clarification of terms seems essential. We must never forget that dividends from mining companies are never wholly profit, but represent both return of capital and profit. The proper allocation of dividends to these two sources is determined by three factors: first the amount of capital required to find an orebody, acquire title, and to explore, develop, and equip the property to deliver a certain pre-determined volume of merchantable product on the market. Second, the length of time required for this purpose, and consequent loss of interest on the capital so employed, and the deferment of profits. And third, the length of time required to exhaust the mine. No doubt, concrete examples would show more clearly the relative incidence of these factors. However, such examples are already available to the industry, in J. R. Finlay's third edition of the "Cost of Mining," to whose inspiration I am indebted for most of my ideas on the economics of mining.

In selecting a group of properties on which to base my study of this third question I have purposely kept away from bonanza mines of the United Verde Extension type, in which, Mr. Finlay points out, the mere discovery of an orebody is the principal element of value in the undertaking, and have confined my attention solely to a group of "porphyry" mines, in which the general environment and choice of methods and equipment are the principal elements.

At the outset we are confronted with the fact that in few cases are we able to separate the purchase price of the property from the cost of development and equipment. For our present purpose, this need be cause for no embarrassment, although it may not be amiss to suggest that the safeguarding of public investments in mining would be made easier by a more definite separation of these items.

I have tablulated below certain items from the 1920 balance sheets of a group of domestic "porphyry" mines, together with their average and maximum annual output for the preceding five years. So far as possible, I have selected those items to represent the amounts of fixed capital required to find, acquire, develop, and equip to produce the output obtained by those mines. As an index of the effect of general environment, and the time required to accomplish this end, I have made similar tabulations for the three large South American copper mines, two of which are classified as "porphyry" mines, while the third might be regarded as similar in character to those of Jerome in this country. It will be noted that the Miami Copper Co. makes a definite separation of the fixed capital invested in mines from that invested in the development and equipment of them. However, in the summary I have omitted the figures of the Miami Copper Co., as that company's item of "mining property" probably includes its "revaluation surplus," and not merely the purchase price and expense incidental to acquiring title to the property.

Braden Copper Co. Consolidated Balance Sheet, 1920

Property, construction and equipment	$40,521,529.00
Deferred charges to mine development, including interest during development period	4,913,505.00
Bonds of B. C. M. Co. held by B. C. Co.	499,460.00
Interest in steamships	394,339.00
Total	$46,328,833.00

Note—This amount purchased the property, developed the mine, and equipped it with mining plant, mill, smelter, and transportation facilities.

Average production 1916-20, lb.	58,000,000
Maximum production 1918, lb.	77,000,000

Cost based on average production, 80c. per lb. of annual capacity.
Cost based on maximum production, 60c. per lb. of annual capacity.

Cerro de Pasco Copper Corporation Consolidated Balance Sheet, 1920

Mines and property	$45,021,674.00
Investments	7,867,134.00
Deferred charges	1,280,000.00
Total	$54,168,808.00

Note—This amount purchased the property, developed the mine, and equipped it with mining plant, smelter, and transportation facilities. In addition it purchased and developed coal mines, coking plant, and railroad from same to the smelter.

Average annual production 1916-20, lb.	64,000,000
Maximum annual production 1917, lb.	71,000,000

Cost based on average annual production, 84c. per lb. of annual capacity.
Cost based on maximum annual production, 76c. per lb. of annual capacity.

Chile Copper Co. Consolidated Balance Sheet, 1920

Property investment	$99,146,859.00
Construction and equipment	23,480,695.00
Investment in steamship companies	1,073,958.00
Deferred charges to development	1,047,820.00
Total	$124,749,332.00

Note—This amount purchased the property from the Chile Exploration Co., and developed and equipped the mine, built a leaching plant, electrolytic precipitating plant, and the necessary railroad and steamship transportation facilities

Average annual production 1916-20, lb.	84,000,000
Maximum annual production 1920, lb.	111,000,000

Cost based on average annual production, $1.48 per lb. of annual capacity.
Cost based on maximum annual production, $1.12 per lb. of annual capacity.

Inspiration Consolidated Copper Co. Balance Sheet, 1920

Real estate, mines, buildings, and machinery	$25,704,812.00

Note—This amount purchased the property, developed and equipped the mine, and constructed a mill, smelter, and transportation facilities.

Average annual production 1916-20, lb.	91,000,000
Maximum annual production 1916, lb.	120,800,000

Cost based on average annual production, 28c. per lb. of annual capacity.
Cost based on maximum annual production, 21c. per lb. of annual capacity.

Miami Copper Co. Balance Sheet, 1920

Mining property	$26,450,685.00
Plant and equipment (mine and mill)	3,208,149.00
Development of mine	1,197,322.00
Total	$30,856,156.00
Average annual production 1916-20, lb.	53,000,000
Maximum annual production 1918, lb.	58,000,000
Total cost of plant and equipment and development	$4,405,471.00

Cost including property based on average annual production, 58c. per lb. of annual capacity.
Cost excluding property based on average annual production, 8.3c. per lb. of annual capacity
Cost including property based on maximum annual production, 53c. per lb. of annual capacity.
Cost excluding property based on maximum annual production, 7.6c. per lb. of annual capacity.

Nevada Consolidated Copper Co. Balance Sheet, 1920

Property account (mine, mill, smelter and railroad)	$17,882,083.00
Deferred charges to operations	5,691,376.00
Total	$23,573,459.00

Note—This amount includes purchase of property.

Average annual production 1916-20, lb.	60,000,000
Maximum annual production 1916, lb.	90,000,000

Cost based on average annual production, 39c. per lb. of annual capacity.
Cost based on maximum annual production, 26c. per lb. of annual capacity

Utah Copper Co. Balance Sheet, 1920

Property and plants	$29,678,350.00
Investments (excluding Nevada Consolidated)	8,884,853.00
Prepaid expense for stripping and similar work	9,853,333.00
Average annual production 1916-20, lb.	156,000,000
Maximum annual production 1917, lb.	195,000,000

Cost based on average annual production, 31c. per lb. of annual capacity.
Cost based on maximum annual production, 25c. per lb. of annual capacity.

Ray Consolidated Copper Co. Balance Sheet, 1920

Property account	$8,656,440.00
Additional expense for construction	12,115,625.00
Investments	3,025,221.00
Total	$23,797,286.00
Average annual production 1916-20, lb.	68,000,000
Maximum annual production 1917, lb.	88,000,000

Cost based on average annual production, 35c. per lb. of annual capacity.
Cost based on maximum annual production, 27c. per lb. of annual capacity.

Summary South American Group

Cost of properties, mills, smelters, railroads, and complementary property	$225,246,973.00
Average annual production 1916-20, lb.	206,000,000
Maximum annual production, lb.	259,000,000
Estimated present annual production, lb.	400,000,000

Cost based on average annual production, $1.09 per lb. of annual capacity.
Cost based on maximum annual production, 87c. per lb. of annual capacity.
Cost based on estimate of present annual production, 56c. per lb. of annual capacity.

Summary North American Group

(Miami Copper not included)

Cost of properties mills, smelters, railroads, and complementary property	$121,492,093.00
Average annual production 1916-20, lb.	375,000,000
Maximum annual production, lb.	494,000,000

Cost based on average annual production, 32c. per lb. of annual capacity.
Cost based on maximum annual production, 25c. per lb. of annual capacity.

These figures show striking uniformity for the domestic group of mines. In the case of the Ray Consolidated Copper Co., no investment in a smelter was required, as a contract was made with the American Smelting & Refining Co. to smelt the concentrates from the Ray mill at its Hayden plant. Similarly, only sufficient railroad was required to connect the mine with the Arizona Eastern at Kelvin, the latter then hauling the ore to the mill at Hayden, and the bullion from the smelter to the main line of the Southern Pacific at Maricopa. Similar advantage has undoubtedly been taken of already existing facilities by the other companies to reduce the amount of their investments.

Depreciation Charges Much Heavier for South American Group

In South America, on the other hand, practically all facilities had to be supplied by the copper companies themselves. Possibly, in the future these companies may receive some return on these outlays, from sources other than their own operations, as the general development of the country proceeds. In the meantime, however, it makes their depreciation charges about three times as heavy as for the domestic group. Of course, the construction of these complete facilities has taken appreciably longer than the partial ones required in the States, and dividends have necessarily been deferred for a longer period after production actually began than they have in this country.

Working capital, our fourth question, is the amount of liquid assets required to finance current production, both of materials for market and dividends. Theoretically, in this country, copper production requires three months from mine to market, and from this angle alone only sufficient liquid capital to finance operations for this period would be needed. It is easy to see, however, that sound sales and dividend policies will require the increase of this amount to six months or even a year. It may be worth while to point out here that the money so tied up has no other function than that of converting fixed capital into product or dividends. No product can be made without it, and consequently no distribution can be made of it in full, until exhaustion of the mine. Any partial distribution must be continually

replaced from converted fixed capital, or the scale of operations must be proportionately reduced. Its present value in the case of a long-lived property will necessarily be very small, and in no case can it be regarded as having greater value than the cost of borrowing a similar amount from the banks.

The Dividend Record

To find the answer to our fifth question, we must examine the history of the dividend-paying copper mines of the United States. The following tables show the production and dividends of a group of copper companies, which, during the last twelve years, produced about 80 per cent of the total for the United States, or nearly 50 per cent of the world's total. The unit of comparison used is the dividends paid per pound produced, disregarding any changes in working capital. The periods are chosen to cover representative conditions prior to the war boom, and to show the effects of the war inflation and post-war deflation. In addition, as a matter of general interest concerning future competition in the copper business, I have included the figures for the South American properties.

Comparison of Earnings of Copper Companies Based on Dividends Paid Per Pound Produced During the Period 1911 to 1922 Inclusive

Performance of companies in the United States which produced about 50 per cent of the World's output for the period.

PRE-WAR PERIOD, 1911-1915 INCLUSIVE

Company	Production, Pounds	Dividends	Cents Per Pound
Ahmeek	76,307,867	$3,550,000	4.65
Allouez	30,497,085	100,000	0.31
Anaconda	1,236,239,397	47,359,375	3.89
Calumet & Arizona	268,796,024	12,529,179	4.66
Calumet & Hecla	313,309,178	16,779,000	5.36
Chino Copper	198,161,840	6,697,995	3.38
Copper Range	134,034,866	4,436,696	3.31
Greene Cananea	175,729,828	3,500,000	1.99
Inspiration Consolidated	20,445,670	.....	.....
Isle Royale	35,778,966	150,000	0.42
Miami Copper	156,214,127	5,416,575	3.46
Mohawk	56,842,662	1,725,000	3.03
Nevada Consolidated	318,548,067	16,245,488	5.10
New Cornelia	Not Producing		
North Butte	117,272,159	3,139,000	2.61
Old Dominion	141,010,599	5,646,721	4.00
Osceola Consolidated	82,828,799	3,990,225	4.81
Phelps Dodge Corporation	692,088,815	34,525,000	5.01
Ray Consolidated	219,293,568	4,593,857	2.09
Quincy	92,483,064	2,337,500	2.52
United Verde	177,645,379	8,550,000	4.25
Utah Copper	562,911,041	18,275,218	3.25
Wolverine	38,062,765	2,000,000	5.52
Totals	5,174,401,766	$201,546,830	3.90
Average selling price			15.37
Per cent profit on selling price			25.3

WAR PERIOD, 1916-1920 INCLUSIVE

Ahmeek	114,825,754	$8,600,000	7.49
Allouez	32,432,646	2,750,000	8.47
Anaconda	1,094,170,892	63,195,000	5.77
Calumet & Arizona	268,164,867	22,747,314	8.36
Calumet & Hecla	332,712,909	16,234,000	4.88
Chino Copper	312,131,939	23,293,714	7.46
Copper Range	135,872,603	11,831,190	8.71
Greene Cananea	231,173,946	13,250,000	5.73
Inspiration Consolidated	456,871,706	38,983,701	8.53
Isle Royale	64,964,588	1,875,000	2.89
Miami Copper	265,592,559	19,028,310	7.16
Mohawk	60,056,178	5,800,000	9.66
Nevada Consolidated	341,664,734	26,792,724	7.84
New Cornelia	146,046,284	1,350,000	0.92
North Butte	90,580,092	2,580,000	2.84
Old Dominion	149,271,843	7,084,782	4.79
Osceola Consolidated	69,881,210	4,807,500	6.88
Phelps Dodge Corporation	674,857,171	51,550,000	7.73
Ray Consolidated	340,238,750	20,928,684	6.15
Quincy	101,902,544	5,225,000	5.22
United Verde	315,430,018	21,075,000	6.68
Utah Copper	778,447,838	69,452,628	8.79
Wolverine	25,602,088	1,950,000	7.62
Totals	6,402,893,155	$440,384,547	6.87
Average selling price			23.35
Per cent profit on selling price			29.4

TOTAL TEN-YEAR PERIOD, 1911-1920 INCLUSIVE

	Pounds	Dividends	Cents Per Pound
Ahmeek	191,133,621	12,150,000	6.35
Allouez	62,929,731	2,850,000	4.53
Anaconda	2,330,410,289	110,554,375	4.75
Calumet & Arizona	536,960,891	35,276,493	6.57
Calumet & Hecla	646,022,087	33,013,000	5.11
Chino Copper	510,293,779	29,991,709	5.88
Copper Range	269,907,465	16,267,886	6.03
Greene Cananea	406,903,774	16,750,000	4.12
Inspiration	477,317,376	38,893,701	8.17
Isle Royale	100,743,554	2,025,000	2.01
Miami Copper	421,806,686	24,444,886	5.79
Mohawk	116,898,840	7,525,000	6.44
Nevada Consolidated	660,212,801	43,038,212	6.52
New Cornelia	146,046,284	1,350,000	0.92
North Butte	207,852,251	5,719,000	2.75
Old Dominion	290,282,442	12,731,503	4.39
Osceola Consolidated	152,710,009	8,797,725	5.76
Phelps Dodge	1,366,945,986	86,075,000	6.29
Ray Consolidated	559,532,318	25,522,541	4.56
Quincy	194,385,608	7,562,500	3.89
United Verde	493,075,397	29,625,000	6.01
Utah Copper	1,341,358,879	87,727,846	6.54
Wolverine	63,664,853	3,950,000	6.25
Totals	11,577,294,921	$641,931,377	5.54
Average selling price			20.26
Per cent profit on selling price			27.3

TOTAL TWELVE-YEAR PERIOD, 1911-1922 INCLUSIVE

Ahmeek	212,273,902	$12,550,000	5.92
Allouez	62,929,731	2,850,000	4.52
Anaconda	2,505,731,248	110,554,375	4.41
Calumet & Arizona	585,253,197	36,800,000	6.25
Calumet & Hecla	701,683,223	39,800,000	5.67
Chino Copper	547,837,375	29,991,709	5.47
Copper Range	308,888,857	16,671,308	5.39
Greene Cananea	433,929,376	16,750,000	3.86
Inspiration Consolidated	562,326,259	38,893,701	6.93
Isle Royale	109,874,524	2,325,000	2.12
Miami Copper	542,573,074	27,433,403	5.05
Mohawk	142,162,471	7,825,000	5.50
Nevada Consolidated	693,337,801	43,038,212	6.27
New Cornelia	192,851,469	3,150,000	1.63
North Butte	218,812,240	5,179,000	2.61
Old Dominion	316,245,379	12,731,503	4.02
Osceola Consolidated	152,710,009	8,990,025	5.89
Phelps Dodge Corporation	1,483,392,384	90,550,000	6.10
Ray Consolidated	597,595,857	25,522,541	4.27
United Verde	546,656,885	32,775,000	6.00
Utah Copper	1,450,648,184	95,038,051	6.55
Wolverine	70,305,156	4,050,000	5.76
Quincy	227,345,873	7,562,500	3.33
Totals	12,665,364,474	$671,031,328	5.30
Average selling price			19.43
Per cent profit on selling price			27.3

Summary

Period	Production, Pounds	Dividends	Cents Per Pound	Per Cent Profit on Gross Income
1911-15	5,174,401,766	$201,546,830	3.90	25.3
1916-20	6,402,893,155	440,384,547	6.87	29.4
1911-20	11,577,294,921	641,931,377	5.54	27.3
1916-22	7,493,528,971	$469,484,498	6.27	29.1
1911-22	12,665,364,474	671,031,328	5.30	27.3

Note 1—In the foregoing tables, wherever companies have received dividends from other companies in the group considered, such dividends have been deducted from the total of their distributions. The companies so affected are Anaconda, Calumet & Hecla, Calumet & Arizona, Phelps Dodge Corporation, and Utah Copper. In the case of Calumet & Hecla, notes issued by that company in exchange for stock in other companies were paid off during the period and have been added to the net total of Calumet & Hecla dividends. Where companies are engaged in other operations than producing copper, all dividends have been credited to copper in arriving at the per-pound figure.

Note 2—The average selling prices were taken from figures published by the U. S. Geological Survey, and weighted against their domestic consumption figures for the respective years and then the averages for the periods found.

Note 3—The total for the ten years 1911-1920 inclusive was 80 per cent of the total United States production for those years as given by the U. S. Geological Survey.

Note 4—1922 production figures for the following companies were not available at the time the tables were made up and have been estimated in the totals for the twelve-year period: Greene Cananea, United Verde, Quincy, and Wolverine.

South American Companies

1916-1921 INCLUSIVE

Company	Production, Pounds	Dividends	Cents Per Pound
Cerro de Pasco	388,261,851	$18,704,428	4.82
Braden Copper	317,460,659	none	none
Chile Copper	475,033,859	none	none
Totals	1,180,756,369	$18,704,428	1.58
North American companies	6,729,485,548	$451,500,104	6.71

Note—There were outstanding on the first of January, 1922, about $72,000,000 in bonds of the three South American companies.

The salient points brought out by these various comparisons, are stated below:

1. The figures indicate the futility of attempting to estimate distributable profits over a period of years by estimating operating costs and projecting selling prices, and point strongly to the marked stability of profit on gross income. In 1918, J. R. Finlay, in discussing the normal profit of mines, wrote as follows:

"But as a practical matter the price level is probably less important to the producers than we are accustomed to imagine. The products of mines are staples, indispensable to the life of civilization. There is a constant demand for them. Some mines can produce more cheaply than others. The cheap producers are profitable; the higher cost producers are only profitable during temporary waves of sharp demand. Following out this line of reasoning it is easy to see that the average profit of a mine is a measure of its advantage compared to other mines; in other words it is determined by competition with other mines. It will be found, for instance, that a given property is able to pay one-quarter of its gross output in dividends. This simply means that three-quarters of its output is consumed in costs, of one form or another, and that the remaining quarter goes to the stockholders. This proportion varies from year to year, but in the long run an average is established and maintained. It seems logical to believe that this proposition will remain as fixed as ever, whatever the level of prices. Thus we may believe that a copper mine which will pay 3c. a pound if the selling price of the metal averages 12c. will be able to pay 6c. a pound if the metal is to average 24c. I am disposed to accept this proposition as a sort of general principle. Perhaps it is an important thing to bear in mind during the uncertainties attending the readjustment and reconstruction that must follow the war. There is, of course, some danger in confusing the changes in the condition of individual mines with the changes in industrial conditions.

"If this proposition is true it involves the following consequences: (1) That changes in price levels which affect all commodities alike are not of fundamental importance to producers, for it is nothing but a change in the value of a dollar. If wages are doubled, costs will be doubled and each producer will have the same amount of goods as before. (2) But a rise of prices is unfavorable to all forms of fixed income and a lowering of prices is favorable to fixed income. Thus if prices are to be double those of the pre-war period the general effect will be to repudiate, or cancel, half the bonds and mortgages of the world, including all national debts, except of course those that were floated during the period of inflation. The nominal value of the older debts will remain the same of course; the real value will be reduced one-half. (3) In the case of staples, including mines, mining dividends and mining stocks, the real value will remain the same, but the nominal value will be doubled."

A study of the summary shows the following facts: During the five years 1911-1915 inclusive, the average selling price or gross income per pound received by producers in the United States was 15.37c., and the dividends paid per pound by them were 3.90c. or 25.3 per cent of gross income. During the seven years 1916-1922 inclusive, the average selling price received was 21.5c. and the dividends paid were 6.33c. per pound, or 29.4 per cent profit on gross income. It is obvious that these figures are in substantial agreement with Mr. Finlay's forecast quoted above. There is good reason to believe that a fairly large proportion of the dividends paid in the second period were actually earned in the first, and for sound reasons, which I will discuss later, were withheld until the second period. If this adjustment could be made in the respective amounts distributed in the two periods, the percentages of profits on gross income for the two would be almost identical, as predicted by Finlay.

2. When we try to reconcile published figures on operating costs with dividends paid to stockholders in copper companies, figures which generally range from 6c. to 12c. per pound, we are confronted with the fact that there is never available for dividends, even for companies which have been operating long enough to have accumulated ample working capital, anything like 100 per cent of the margin between operating cost and selling price. Every large part of this operating profit is necessarily absorbed in one of several ways. First, in the acquisition of territory to safeguard and prolong the life of the property. Second, in the alteration of plants to meet competition in costs. Third, in enlargement of capacities to increase volume of earnings.

3. The greatly accelerated growth of taxation since the war has had an important effect in holding profits down. The optimists tell us that this is only temporary. Still there is little consolation to be found from a study of the history of taxation. That it is not an unmitigated evil might be inferred from the comparative results obtained in this country and those less highly organized, and consequently less expensive to govern.

4. Returning for a moment to the comparison of the two periods, it should be appreciated that, during the pre-war period, many companies like Utah Copper, Nevada Consolidated, Ray Consolidated, Chino Copper, and Miami Copper were newcomers in the field, with barely sufficient working capital to meet their needs. Common prudence required that dividends should be held back until such time as the directors felt that any emergency could be met without recourse to the banks. A comparison of earnings for the same periods would undoubtedly show an even more marked stability in the percentage of profit on gross income. Again, if we reduce the dollars of the second period to the purchasing power of the first, we find that, in terms of actual wealth, the companies distributed little if any more per pound of production to their stockholders during the period of high prices than they did in the period of low prices. For illustration, if we assume that the average dollar distributed during the second period had 65 per cent of the purchasing power of that distributed in the first, the figures would be:

Dividends Paid Per Pound

1911-1915	1916-1922
3.90 cents	4.11 cents

In other words, those companies that can maintain their relative ability to compete with the average costs of the industry should not be unduly elated over the prospect of a period of high prices, or unduly depressed over one of low prices. Of paramount importance to them is this ability to compete.

The history of the South American copper mines to date presents a good example of how under certain conditions operating costs below the average may not result in dividends even up to the average. The 1,180,750,000 lb. produced by the three mines of importance in that continent would have produced nearly eighty millions in dividends in the United States, while under conditions down there they have been able to pay $18,704,428. Perhaps it is a little early to use these figures critically. Nevertheless, it may not be inappropriate to compare results as far as they have gone, particularly in view of the serious apprehensions which have existed in many minds as to the ultimate effect on domestic producers of competition from this source.

The effect of general environment can be well observed, in the record of the Cerro de Pasco company. Though the present company dates from 1915 only, its

predecessors have produced copper since the early '90s, and production from the associated silver deposits dates back to the days of the Incas. It is distinctly not a newcomer. During the six years from 1916-1921 inclusive, it produced 388,261,851 lb. of copper, and paid $18,704,428 in dividends, or 4.82c. per pound. In the same period, the average North American company paid 6.71c. per pound in dividends, or 39 per cent more. To secure a somewhat more direct comparison, although the nature of the two deposits is very different, let us take the case of the Nevada Consolidated Copper Co. In the same six years, this company made a slightly lower output—namely 351,027,059 lb., and paid out $26,792,724 in dividends, or 7.63c. per pound. This is 58 per cent more than the Cerro de Pasco company. At the close of business Dec. 31, 1921, the company's statements showed an excess of current assets over current liabilities for the Cerro de Pasco of $12,334,157 and $7,154,162 for the Nevada Consolidated. But the former had $7,997,000 of 8 per cent bonds outstanding, while the latter had none. There can be no doubt of the tremendous handicaps imposed by the general environment in such a locality as the Peruvian Andes.

As neither Braden nor Chile Copper had paid any dividends up to 1922, no real comparisons can be made as yet. It is interesting to note, however, that Inspiration Consolidated, which began producing in the same year—namely, 1915—shows a total output of 492,492,144 lb., compared with 484,614,502 lb. for Chile in the seven years ending Jan. 1, 1922. On this production it paid $38,983,701 in dividends, or 7.92c. per pound. This latter figure is a record surpassed by few companies for the same period, and by none whose initial production was as late as 1915.

Similarly, Miami Copper and Braden both began production in 1911, and up to 1922 had turned out 475,118,627 lb. and 408,089,288 lb. respectively. On this output Miami Copper paid $25,939,175 in dividends and showed a net balance of quick assets of $6,311,443, whereas Braden paid no dividends and showed an excess of current liabilities of $9,494,655 in addition to $13,416,000 of 6 per cent bonds outstanding. Neither Inspiration Consolidated nor Miami Copper has any bonded indebtedness. These facts, together with those covering the relative investment in mines and plant, cited earlier in the discussion, strongly reflect the relatively unorganized condition of Chile when compared to a highly industrialized country like the United States, and the inherent added difficulties of establishing industrial operations. Such difficulties absorb both capital and time.

In this connection, it is idle to suppose that just as great ability has not been engaged in the direction of these enterprises outside as in those of their competitors inside the United States. Still there may be some reason for believing that the keener technical competition in this country may have a wholesome effect in eliminating poor practice more rapidly. There is nothing more stimulating to human activity than keen competition, constantly in sight.

As a parallel case to that of the South American companies, we might cite that of the Greene Cananea Consolidated Copper Co. Although I have included it among the North American producers, owing to its location in Old Mexico, it has suffered from similar difficulties, which have not been lessened by the chronic disturbances in that country for the last ten years. During the ten years ending 1920, it was able to pay only 4.12c. per pound, while the average North American producer paid 5.54c. per pound.

Before proceeding to my conclusions, I want to call attention to one more fact of history, which has to do with the world's consumption of copper. The late Dr. James Douglas found what he regarded as a very significant relation between the production of copper and that of pig iron. Extending over a period of many years prior to the Great War, the world produced a pound of copper to every 83 lb. of pig iron. This ratio seemed to be fairly constant from year to year. Beginning a few years prior to the war, this ratio was materially reduced. In other words, the production of copper increased much more rapidly than that of pig iron. I have listed below the ratios for the year 1913, and the years from 1917 to 1922 inclusive.

Ratio of the World's Production of Copper to Pig Iron

1913	1917	1918	1919	1920	1921	1922
1–79	1–49	1–45	1–52	1–61	1–66	1–55

That these figures apply with equal force to consumption should be obvious when we remember that production and consumption have just about balanced each other at the present moment.

In 1914 one pound of copper in the United States would buy 20 lb. of pig iron. At present prices, it will buy less than 10 lb. Similar comparisons might be made with other pairs of commodities. The point which I wish to bring out is that there are temporary maladjustments in the commodity markets, even in those as closely related to each other as the leaders of the metal industry. Whether copper should go up and stay up to a parity with steel at its present price, or whether steel should come down to a parity with the present price of copper, is something that time alone will tell. But to me the logic of believing that the prices of these two most important metals should move in fairly constant relation seems inescapable.

From the standpoint of consumption, the present relative cheapness of copper is an added advantage. This condition tends to expand the fields in which it has already found favor, and also to promote its introduction into new fields of usefulness. Once established in such new fields, it will be hard to displace even if its relative cost should increase materially.

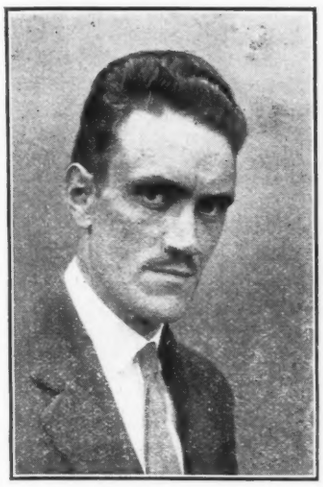
In conclusion, I offer the following suggestions: First, that we may dismiss any hopes or fears of failure in the sources of supply for the copper market for the present generation at least. Second, that we may look forward confidently, in spite of any present demoralization of markets, to an increasing consumption of copper throughout the world. We may even expect for a time to see the consumption of copper increase relatively more rapidly than that of pig iron and steel. Third, it is difficult to upset the logic of the argument that, in the future as in the past, the industry will require an average selling price which will yield a profit of 25 per cent on gross income to the average producer, after allowing for all reasonable charges for capital expenditures and depreciation of plants. And lastly, there is no reason for believing that copper from other sources than the United States can be produced at a cost that will yield dividends (which after all, are the real measure of profits) in any greater amount than the average yield in the United States.

In closing, I wish to acknowledge my indebtedness to E. N. Skinner, mining engineer, of 25 Broad St., New York, for the many valuable data assembled in his admirable Bulletin on Copper Share Statistics.

Electrical Equipment of Rosario Mill and Mine

An Account of the Practice at an Isolated Plant—Reasons for Selection of Machinery Used

BY FREDERICK KRUG
Electrical Engineer, Formerly With New York & Honduras Rosario Mining Co.



Frederick Krug

THOUGH the use of electricity in the mining and milling of gold and silver ores has reached a high state of perfection, little has been written describing the practical results obtained with equipment installed. The plant of the New York & Honduras Rosario Mining Co. at San Juancito, Honduras, Central America, is of particular interest in this connection, because of its isolation and the attendant difficulties of proper maintenance.

The mine is situated about one hundred miles from Amapala, the only Pacific port of Honduras. From Amapala, passengers and freight are transported about twenty miles by small river boats to San Lorenzo, from which point an automobile road connects with Tegucigalpa, the capital of the country. From the capital to the mine, a distance of twenty miles of mountain trails, the only means of transportation possible is on mule-back and ox carts. The average time that ox carts require to make these twenty miles is about a week. Saddle mules will cover the distance in about seven hours.

In spite of this handicap of location, the Rosario mine has been extensively operated for nearly forty years, and evidence is available showing that silver was extracted as long ago as the eighteenth century. The mine is situated about 5,000 ft. above sea level and is in the midst of some of the highest mountains in the country, reaching elevations of over 7,000 feet. The precipitation for about nine months of the year is heavy, resulting in an ample supply of water for power purposes. This, coupled with the naturally advantageous topography of the locality, has made possible the development of two hydraulic power plants of sufficient capacity to supply all the power requirements of the mill and mine.

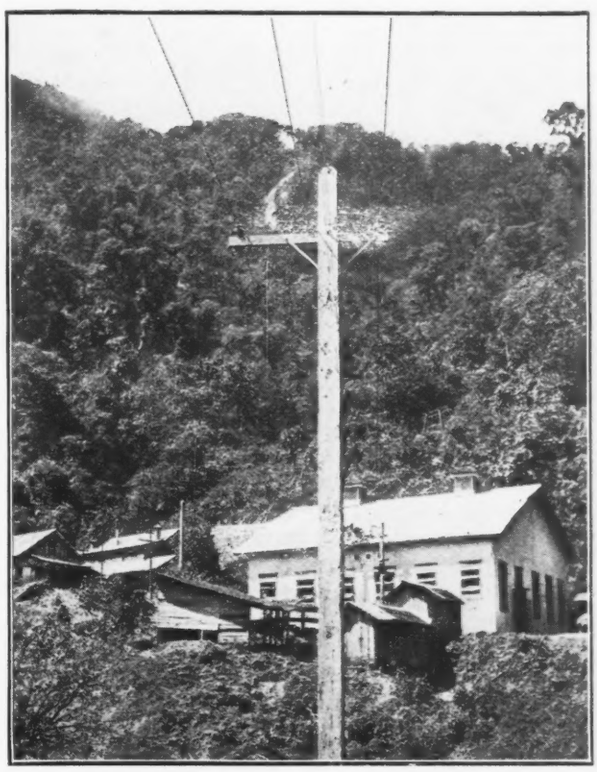
POWER PLANTS DEVELOP 2,100 HORSEPOWER

These two power plants utilize the same water in series. The upper or San Juancito plant operates under a head of 1,355 ft. and has two 600-hp. Pelton wheels direct-connected to two 350-kva. generators. The water for this plant is supplied by two wooden flumes, one 7,300 ft. long and the other 9,600 ft. long, terminating in a water box, at which point the water enters the penstock. The tail water from this plant again enters a flume, which is also supplied by another small stream. This flume carries the water for the lower or Guadalupe plant, which operates under a head of 500 ft. and has two 450-hp. Pelton wheels direct-connected to two 350-kva. generators. It will thus be seen that the total power that can be developed by these plants is about 2,100 hp.

The power is transmitted as generated at 6,600 volts, three phase and 60 cycles a distance of four miles to the cyanide mill and nearly six miles to the mine compressor plant. Duplicate lines are provided from a switch house (at which point the lines from the two plants join) to the mill, thus making it possible to operate the mill from either plant independently or to operate on one line in case of trouble. This duplicate line was installed to enable the maintenance force to make line repairs without interrupting the service to the mill.

MILL TONNAGE DOUBLED SINCE START

The mill was originally designed and built to handle 200 tons of ore per day. As is usual, this was pushed to the limit, until at present the average amount of ore milled is about 400 tons per day. This increase in capacity has been attained with practically no additions

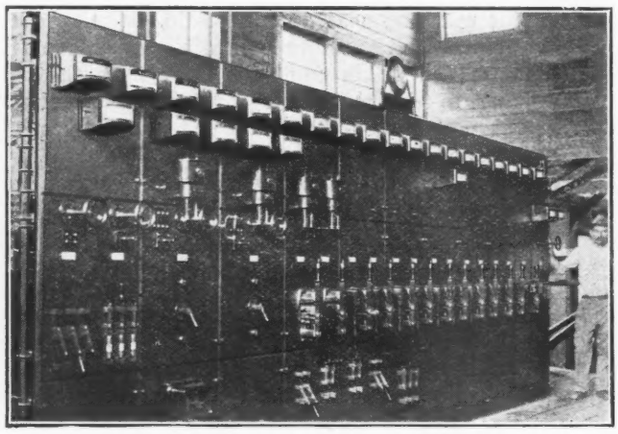


Exterior view of mine compressor plant, showing also 6,600-volt transmission line construction used.

to the electrical equipment of the mill, showing the wide variation of loading to which a given design for the electrical department of a mill may be subjected.

Contrary to the usual practice in the western part of the United States, where 440 volts is most generally used for mill work, a voltage of 2,200 was adapted in the mill for all motors to and including motors as small as 15 hp. There are but two exceptions to this in the entire mill, a 15-hp. and a 35-hp. motor that were available from the old works. These operate at 220 volts where it was convenient to place them near a lighting transformer bank. All other motors under 15 hp. operate on 110 volts from these transformers.

From experience with the use of 2,200 volts in this mill it is my opinion that this voltage ought to be given more consideration in new designs than it receives at the present time. This is particularly true where the mill buildings are somewhat scattered and the feeders necessarily quite long.



Switchboard at mill substation.

The mill substation is provided with two banks of transformers consisting of three 125-kva. transformers each, to step down the voltage from 6,600 to 2,200 volts. For lighting and small motors there are three banks of three 15-kva. transformers each to reduce the voltage from 2,200 to 220 and 110 volts. These three banks are situated at the three heaviest load centers for these voltages. The mill switchboard has standard distribution panels equipped with oil circuit breakers and overload trip coils. There is an ammeter for each circuit, and one power-factor meter serves the entire board by means of plug switches.

Tube Mills Take Most Power

The heaviest power consumption in the mill is in the process of pulverizing the ore. The first step, crushing the ore as it comes from the mine in gyratory crushers, consumes the least; grinding in the tube mills is responsible for the consumption of more than a third of the total mill power.

The actual average percentages for the various processes are as shown in Table I, giving the distribution of mill power.

The two Gates gyratory crushers at the head of the mill were formerly each independently belt-driven by a 25-hp. motor. A countershaft was run, and both crushers were belted to one of the motors only. Even with the greatly increased mill capacity this arrangement, due to the intermittent character of the load, has been in entirely satisfactory operation for several years. The only trouble ever experienced with crusher motors has been due to some of the ore or pebbles being carried to the motor on the belt and getting between the rotor and stator. To prevent this, heavy screens were fastened on the pulley-side end bell of the motor, and this has entirely obviated the difficulty.

Table I—Electrical Power Distribution for a Typical Month

Used for	Per Cent of Total	Kw.-Hr.
Mill power	57.0	346,366
Mill lights	0.5	3,038
Mine power	35.0	212,601
Mine lights	0.3	1,823
Electric haulage	4.0	24,307
Surface power	2.0	12,153
Surface lights	0.5	3,038
Machine shop	0.4	2,431
Laboratory	0.3	1,823
Total	100.0	607,660

Distribution of Mill Power

Used for	Per Cent of Total	Kw.-Hr.
Crushing	2.3	7,966
Stamping	18.0	62,346
Grinding	36.0	124,692
Pumping	22.0	76,201
Agitation	21.7	75,161
Total	100.0	346,366

Power Supplied

Power plant	Per Cent of Total	Kw.-Hr.
San Juancito	61.4	372,830
Guadalupe	38.6	234,830
Total	100.0	607,660

Table II—Connected Motor Load in Horsepower

Location and service	Number of Motors	Connected Hp.
Mill		
Crushers	1	25
Stamp battery	3	385
Tube mills	3	225
Pumps	10	220
Air compressors	2	100
Agitation	6	26
Precipitation process	7	32
Mine		
Air compressors	2	560
Electric haulage 2 M-G sets for 6 locomotives		110
Shops	3	17
Electric and machine shops		
Machine drive	4	27
Laboratories		
Crusher and blower	2	6
Surface department		
Carpenter shop	1	35
Refrigerating	1	5
Lighting load equivalent, hp.		
Mill	..	12
Mine	..	6
Surface	..	29
Total	45	1,820

The stamp batteries consist of twenty 1,850-lb. stamps. These are placed in battery groups of five stamps, and each group is separately belted to a main countershaft, which is driven by a 200-hp. synchronous motor. A 150-hp. synchronous motor is also available as a spare, and either of these units can be started by means of a 35-hp. induction motor and placed on the line by men of little experience, by means of an automatic synchronizing device. Each motor has its own exciter belted to it, and a spare exciter is motor-driven and so arranged by means of a double-throw switch that it can be made to serve either synchronous motor in case of exciter trouble. By these means continuity of operation is assured the stamp battery so far as it is possible to do this with the electrical equipment. These two units were formerly generators in an old plant, and, being available when the mill was built, were utilized for the stamp-battery drive.

The disadvantage of having all stamps driven by one motor is that in case of electrical trouble the entire mill-

ing process is held up. Belt trouble will also cause a complete shutdown of all the stamps until the belt can be freed. For this reason it is the usual practice to have an independent motor on each battery group, or at least two motors, one for each half of the total stamps installed. In this way a complete mill shutdown can be averted in case of even serious stamp-battery trouble.

The average load on the stamp-battery synchronous motor is 110 hp., and when the 200-hp. motor is in service considerable capacity is available for power-factor correction. The motor is then operated with a 50-per cent leading power factor, which results in a mill power factor of about 90 per cent against approximately 75 per cent without correction.

The mechanical efficiency of a stamp-battery drive can be simply calculated from the formula

$$\text{Horsepower} = \frac{Q \times N \times W \times D}{33{,}000}$$

In which

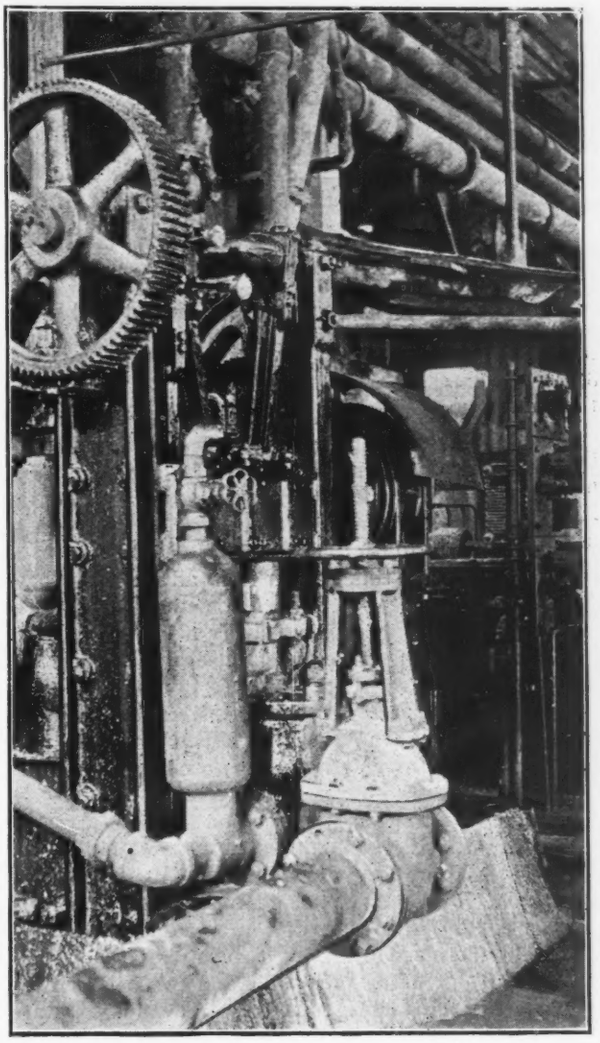
Q = Total number of stamps.
N = Average number of times each drops per minute.
W = Weight of each stamp.
D = Average distance dropped by stamps in feet.

This represents the direct input to the stamps, and the result so obtained divided by the electrical input in horsepower will give the over-all mechanical efficiency of the drive. A stamp-battery load is constant, except that the height that the stamps will fall will vary slightly with changes in the rate of feeding the ore; hence the best efficiency is obtained when the ore is being crushed as rapidly as possible.

Tube Mill Motors Should Be Accurately Adjusted to Load

At the Rosario mill three 5x22-ft. tube mills are in operation, two for coarse grinding and the third for regrinding the oversize material from the first two. Each of these mills is driven by a 75-hp. slip-ring induction motor through a flexible coupling and gear-and-pinion drive. These motors are equipped with reversing starters, so that the mills can be rolled first in one direction, then in the other, to facilitate starting up a fully charged tube mill. For maximum grinding, the speed of the tube should be such that the charge of pebbles and ore is kept constantly rolling down hill, but not carried over by centrifugal force. A tube-mill load is constant, though it will vary somewhat with the amount of pebble charge and the rate of feed. As the tube mills consume so large a portion of the mill power, it is essential that the motor size be adjusted as accurately as possible to the tube-mill loads in order that the mill power factor may be good. The tube-mill motors at Rosario are practically under constant full load when the mills are fully charged, resulting in an average power factor of over 80 per cent.

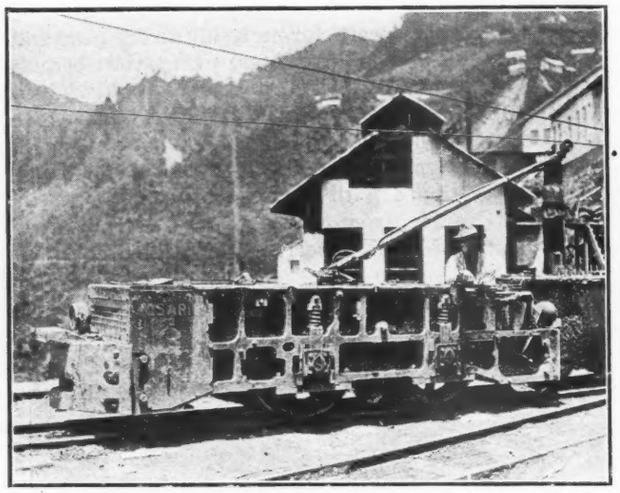
Referring again to the table on distribution of mill power, it will be noted that the power consumption for pumping is 22 per cent of the total mill power. This is divided among ten motors as follows: three triplex pumps and one centrifugal pump, to pump mill solution from the thickeners back to head of mill for the stamps and classifiers; three triplex pumps to pump the rich solution up to the refinery, and three triplex pumps for the zinc precipitation process. No slime pumping is necessary, as the mill is so situated that all slimes are carried by gravity. The motors for these pumps vary in size from 15 to 35 hp., and are all the slip-ring induction type. They were formerly all direct gear-and-pinion connected to the centrifugal pumps, but because of the high motor speed, 900 r.p.m., the resultant vibration, particularly in the large sizes, caused frequent motor troubles. Two of the 25-hp. motors, driving 10x10 triplex pumps and subject to continuous heavy duty, were equipped with flexible couplings, with the result that trouble from vibration was entirely overcome. No trouble was experienced with gear drive at a motor speed of 900 r.p.m. up to 15 hp., but above that and up to 50 hp. a motor speed of 720 r.p.m. will give much more satisfactory results. If a flexible coupling or belting is introduced, a speed of 900 r.p.m. will give good results up to 50 hp. or more.



Aldrich triplex solution pump in mill driven by 15-hp. motor. (Note drip shield over motor and automatic control panel operated by float switch.)

Too High Motor Speed Expensive in End

The installation of motors of too high a speed for a given drive, though they result in a saving in first cost, will invariably prove much more expensive in the final analysis, because of high repair and maintenance charges. The drive should be made as efficient as possible, so that the highest-speed motor compatible with good operating results can be installed. The centrifugal pump has the advantage that a true direct motor



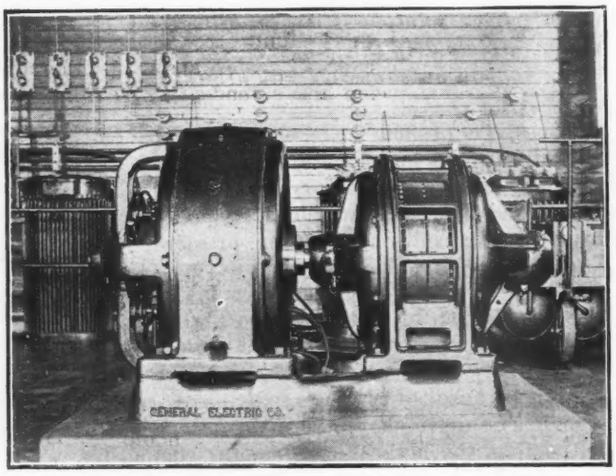
A seven-ton mine locomotive.

drive may be secured, and in this respect is much superior to the triplex pump. The higher speeds are preferable for such drives, and 1,800 r.p.m. and even 3,600 r.p.m. is not uncommon for centrifugal pumps in the smaller sizes.

Agitation by mechanically revolving arms in the thickeners and storage tanks is taken care of by a 15-hp. motor and also several small motors of 1 and 2 hp. each. A reliable and continuous supply of power is essential here, for the rakes become embedded in the settled material and are difficult to start if a shutdown is of any duration. For this reason it is advisable to have the motors on this type of drive somewhat oversize to provide good starting torque. It is also well to have the weakest link in the chain of mechanical operation one that is easily repaired, so as to prevent stripping of gears or excessive torsional strains on the rake supports or column. The most satisfactory method of accomplishing this result has been to design the rakes so that they can be pinned to the column.

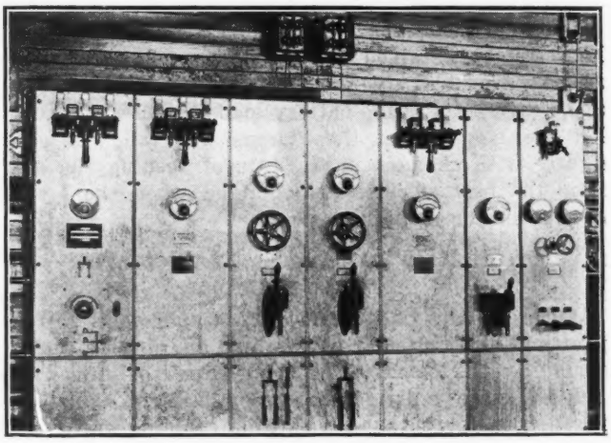
The heaviest agitation is carried on in eight 15x45-ft. Pachuca tanks, and the compressed air is supplied by an Ingersoll-Rand compressor of the Imperial type, driven by a 75-hp. squirrel-cage induction motor, and two other small compressors driven by a 25-hp. motor.

Four classifiers are in service, two between the stamps and the coarse-grinding tube mills and two between the latter and the regrinding tube mill. The first two are driven by a 3-hp. 1,200-r.p.m. motor belt-connected and the lower two by a 2-hp. 1,200-r.p.m. motor similarly connected. As the failure of a classifier motor or belt requires the immediate stoppage of feed to the stamps, and a consequent hold-up in the whole milling process, it is advisable to install motors at least twice the size required by the normal load. This also applies to small motors driving elevators, conveyors, concentrating tables and wherever the driven machine is apt to be choked by excessive feed at any time. Though the efficiency and power factor of motors thus underloaded is not good, the total effect on the system is negligible because of their small size. From experience with classifiers operating in parallel it would also seem preferable to have individual motor drive for each classifier, thus making it possible to shift most of the charge to one classifier when trouble is encountered on the other.



Motor-generator set for mine locomotives.

The mine is worked entirely through tunnels and a series of chutes through which the ore is sent to the lowest level, which is also the mill level. The only electric power used, therefore, in the mine is for compressed air and for electric haulage.



Switchboard at mine substation.

The mine compressor plant at present consists of two Ingersoll-Rand two-stage compressors with intercoolers. The capacity of each compressor is 2,100 cu.ft. per minute at 90 lb. pressure and a speed of 189 r.p.m. Each is driven by a 280-hp. 440-volt three-phase induction motor. These motors have always given entirely satisfactory service, though in most new installations it is the practice to install synchronous motors for compressor drive. This is particularly important where power is purchased on a power-factor basis. In this instance, however, considerable power-factor correction was obtainable from the synchronous motor driving the stamps in the mill, and it was not thought necessary to install this type of motor for the compressors. The compressor plant is provided with three banks of three 100-kva. transformers each, which step the voltage down from 6,600 to 440 volts.

Electric haulage is carried on in two tunnel levels, and six trolley mine locomotives are in service. The trolley voltage is 250 direct-current, and each of the two levels has its own motor-generator set. That for the mill level is at the mill substation and has a capacity of 60 hp., and the set for the upper level is at the compressor plant and has a capacity of 50 hp.

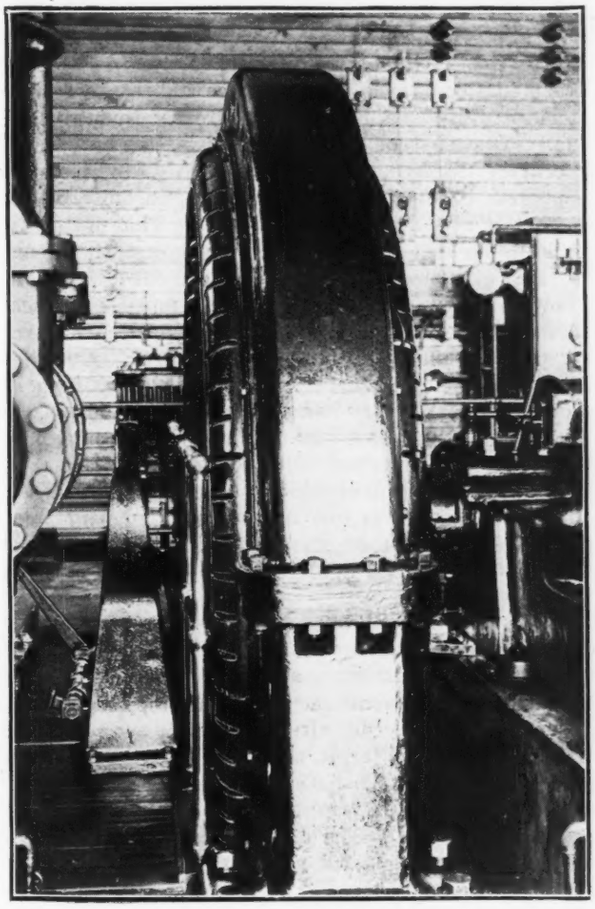
The six locomotives range in size from four to seven

tons. The last two locomotives purchased are of the bar-steel frame type, equipped with ball-bearing interpole motors, and these have given exceptionally good service as compared with the older styles. The flexibility of the framework is a considerable factor in lessening damage due to collision and rough handling such as are common around a mine. Mine locomotives are subject to severe service, particularly in wet mines, and should have regular and thorough inspection and overhauling at stated intervals. Sufficient attention is rarely given to the trolley circuit, connections, and bonding The effect of insufficient feeder capacity, poor connections, and bonding is to cause an excessive voltage drop, the stalling of locomotives with load, and the burning out of armatures because of the excessive current drawn from the line.

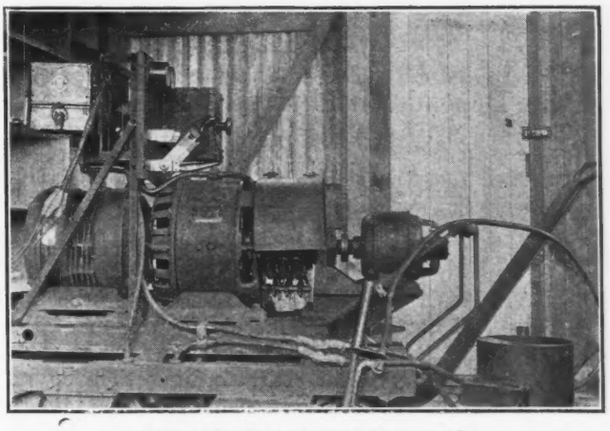
MILLING POWER CONSUMPTION IS COMPARATIVELY LOW

The average power used in the mill is approximately 27 kw.-hr. per ton and that in the mine 17 kw.-hr. per ton of ore mined. The figure for milling is quite low for a mill of this size, though comparative figures of this kind mean little without a knowledge of all the factors involved in each case. That for the mine is perhaps a little high, which can be accounted for in part by the practice of blowing out the mine with compressed air between shifts and by the development work being carried on.

The use of a portable electric-arc welding outfit around the mill and mine has resulted in a considerable saving on repairs and replacements. The type of repairs made ranges from building up worn crusher parts to putting patches on steel tanks. It has been found particularly useful for the numerous repairs continually necessary on mine ore cars and has become an indispensable piece of apparatus of the repair and maintenance equipment.



One of the 280-hp. motors at mine compressor plant.



Portable electric welding outfit.

Queensland Black Opals May Be Mined

In Queensland, Australia, is found the finest black opal in the world. The locality of the principal deposits is the arid plains of the far west, about 500 miles or more inland and from 100 to 200 miles from railway communication. Opal mining has been here carried on intermittently for many years by individual "fossickers," who have gone hunting for the stone when they had nothing better to do; but in favorable seasons the high wages paid on the farming districts are more attractive than the uncertain occupation of searching for the gem stone, while in dry periods, when there is less work on the farms, there is no water for the opal prospector and no water for his horse.

As a further adverse factor, there has usually been uncertainty as to the opal market. Recently, however, comes advice from the Australian Trade Commissioner in the East that there is a good sale for opal in China, and that that country would take £30,000 worth per annum if it could get it. This amount could certainly be obtained in Queensland alone, but the task of getting it would have to be undertaken on a systematic and comprehensive scale by a company or companies prepared to face a large preliminary expenditure before any return could be expected. Perhaps something will now be done to develop and extend the possibilities of the opal trade.

Maybe the Officials Smoke Cigars

There is one offender that it is impossible to reach under the Idaho laws, "blue-sky" or general, said Stewart Campbell, Idaho State Mine Inspector, recently, and he is the continual "assessor"; in other words, there are a great number of companies, owning patented property, that are not spending a dollar on the property, yet every year they are levying assessments against the stock. What this money is used for and where it goes no one knows. This is a practice that should be stopped, although Idaho has no laws to control it and the inspector is powerless.

Marketing of Diatomaceous Earth

Value Depends on Physical Rather Than Chemical Characteristics—Used for Filtration, and for Heat Insulation—Many Less Important Applications May Be Developed

By Norris Goodwin
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DIATOMACEOUS EARTH[1] differs from other industrial earths and minerals by reason of the fact that its commercial value depends far more on its microscopic physical characteristics than on its chemical analysis. It derives its name from the minute vegetable organisms known as diatoms, whose siliceous skeletal remains make up the light fluffy material known in commerce as diatomaceous earth. Since the microscopic physical characteristics are so important a factor in its commercial application, a word concerning its geologic history will be relevant.

Diatoms are classified by the microscopist along with the algæ and are found universally inhabiting waters exposed to light and air. Very rarely they occur in sizes barely visible to the naked eye, but by far the general run of diatoms are distinctly microscopic. They are unicellular and possess the remarkable faculty of secreting a tiny siliceous skeleton or armor much resembling a pill box in structure. Like a pill box, each diatom skeleton is composed of two disk-like valves sliding one upon the other. More remarkable still is the fact that these diatom valves exist in thousands of fantastic shapes, each characterized by a particular design, appearing under the microscope as a delicate engraving, whose composition is peculiar to each individual type of diatom. So true to type are these designs that a skilled microscopist can, after a careful examination, hazard a remarkably accurate guess as to the particular point of origin of the sample.

Manner of Formation of Deposits

When the diatoms die they settle to the bottom, their protoplasmic bodies decompose (according to some authorities with a consequent production of petroleum), and their siliceous skeletons accumulate in a bed more or less intermingled with other mineral substances present in the water. By a normal sequence of geologic events these beds become a component part of certain sedimentary strata and are to be found as diatomaceous earth. In varying degrees of purity it is to be found in nearly every state of the Union and in every country of the globe. As is natural, when due consideration is given to the mode of origin, most of these deposits are badly intermixed with silt, calcareous matter, and partly decomposed organic remains. Furthermore, being soft and chalky by nature, exposed deposits are rapidly eroded.

Probably the largest, purest known deposit and the most important from an economic standpoint occurs along the coast of Southern California. Another deposit of importance occurs in Germany, and the French have recently opened what is reported to be a deposit of considerable magnitude in Algeria. Numerous deposits of lesser magnitude and importance have been worked from time to time in other localities, but do not exert an appreciable influence on the market for the material as it exists today.

[1]Diatomaceous earth and infusorial earth are different names for the same mineral. Tripoli, often confused with diatomaceous earth, is a residum from the decomposition of siliceous limestone; it does not come from diatoms.

Commercial Utilization

From a chemical standpoint diatomaceous earth may be considered as amorphous silica. It owes its value to two characteristics: (1) extreme porosity, with consequent low apparent density; and (2) relative chemical inertness. The number of uses to which it has been put run into the thousands, yet only a few are of sufficient importance to give it a standing as an industrial mineral.

First and most important is its use as a filtering material. Its value in this respect depends on its extreme porosity; when mixed with liquids ordinarily slow and difficult to filter, it builds up within the filter cake a lattice-like structure which allows free passage for the filtrate yet holds back the finer particles which ordinarily clog the filter leaves, with consequent retardation of the rate of filtration. In short, it lends to the filter cake a portion of its own characteristic porosity, speeding up filtration and contributing materially to the clarity of the filtrate.

Next in importance is its use as a heat insulating material. Here again it is the porosity that gives it value. (Diatomaceous earth will absorb as high as 80 per cent of its own volume of water). Air is one of the poorest conductors of heat known, in spite of the fact that it is a fairly good conveyor. That is to say, it will absorb heat from a warmer object and then move away and give this heat up to a cooler one by contact. If, however, movement of the air is stopped, then heat transfer is also largely stopped. Diatomaceous earth accomplishes this to a remarkable degree. Consider that it has been demonstrated that one cubic inch of diatomaceous earth may contain as many as 50,000,000 individual diatom valves, and that they may occupy only 20 per cent of the actual volume, and some idea may be gained as to the discontinuity of the contained air. Diatomaceous earth is one of the most efficient commercial heat insulators known for all temperatures between 200 and 2,000 deg. F.

Extending Minor Uses

Recently, diatomaceous earth has been introduced into building construction as a sound-deadening material to replace the more commonly used felts. Though some modifications in structure are necessary to accommodate a finely powdered material, the results have been more than gratifying and when the reduced fire hazard and freedom from vermin are considered, the additional expense is not great. The development of this market is a matter of educational advertising, and, owing to the difficulties and expense of transportation inherent to the material, must necessarily be confined to the producing regions.

Among the minor uses we may include the following: As an inert mineral filler in insecticides, fertilizers, plaster compositions, magnesite compositions, and rubber; in fact, wherever it is desirable to have a filler that will contribute volume without greatly adding to the weight. As a detergent or mild abrasive it has found considerable application in soaps, dentrifices, and metal polishes. Some material of good color has been used as a compound of cheap paints. Its great porosity and consequently large surface has led to its use as a carrying agent for catalysts.

Many other uses could be enumerated, but they form but a small fraction of the market and are not as yet at least of practical importance.

Production Methods and Grades

Diatomaceous earth is mined almost entirely by open-cut methods. The freshly quarried material generally contains water to the extent of 50 per cent or more, and the general procedure is to stack it in open piles or windrows to allow natural drying in the air. Artificial drying by various means has met with some success. When dry, the crude lumps are pulverized and disintegrated in specially designed equipment, and the finer material is then graded and classified, according to its apparent density, by means of an elaborate system of air flotation. The material of different grades is then sacked and is ready for the market.

Great care must be observed in the disintegration process, for if the grinding action is too vigorous the delicate structure of the diatom valves will be destroyed, with consequent increase in the weight of the finished product. When properly processed the fractions collected will range between 8 and 30 lb. per cubic foot, apparent density. In general, screen analyses are difficult to make and unreliable in an extreme, due to the tendency of the delicate valves to break themselves, as well as to clog the meshes of the screen. Foreign siliceous matter, not of diatomaceous origin, such as sponge spicules, is generally present in irregular shapes.

The purest grades of diatomaceous earth should run about 94 per cent silica and 6 per cent water when thoroughly air dried. This degree of purity is rarely found, and most of the commercial materials on the market will will fall within the following limits:

Constituents of Diatomaceous Earth

	Range, Per Cent	
Silica (SiO_2)	65.0	95.0
Iron and aluminum oxides (Al_2O_3, Fe_2O_3)	8.0	0.2
Lime and magnesia (CaO, MgO)	7.0	0.1
Potassium and sodium oxides (K_2O, Na_2O)	5.0	0.0
Water and organic matter (H_2O and organic)	15.0	4.0

For many uses the nature of the impurities is of little consequence, their effect upon the apparent density being the only consideration. For use in filtration, the nature of the liquids to be filtered will be the governing factor, whereas when used as a heat-insulating material the maximum temperatures to be met will show the allowable limits of fluxing constituents.

Physical Characteristics Determine Application

In almost every instance it is the physical (generally microphysical) characteristics that govern the grade of material most desirable for a given use. Consideration must be given to the nature, type, size, and condition of the individual diatom valves, as well as to the nature and proportions of non-diatomaceous material. For filtration purposes it is generally considered that large, well-developed, unbroken diatom valves are desirable. For heat insulation there is reason to believe that the material giving the greatest number of air cells per unit volume is the most desirable, particularly at high temperatures. In any event actual test under working conditions should be made with the material under consideration, as there is a wide variation in the properties of material taken from two levels in the same quarry. This is even more true of two materials from different localities.

The question of color in diatomaceous earth has received rather more attention than it rightfully deserves. The crude material varies from almost pure white to pink, gray, green, or brown, depending on the nature of the impurities. Frequently a white material will show on analysis a higher percentage of injurious impurities than one slightly colored.

Diatomaceous earths fall naturally into two groups, those of salt-water and those of fresh-water origin. A microscopic examination is sufficient to distinguish between them. Up to the present time nearly all of the marketed material has been of the salt-water type. While this material is possibly somewhat superior for insulation and filtration purposes, there is no good reason why material of the fresh-water type should not find a definite place in industry.

Market Material of Varied Form

Diatomaceous earth is marketed today not only in the form of the powders described above but as aggregate, crude lumps, sawed crude brick and blocks, kiln-burned bricks, and composition blocks. Filtration calls almost entirely for the powders ranging from 12 to 17 lb. to the cubic foot apparent density. Heat insulation takes the material in any and all of the conditions described above. Sound-deadening for buildings calls for a material midway between the powders and aggregates.

The powders and aggregates are packed for shipment in burlap bags holding between 90 and 100 lb. each. The cost of containers is a serious item, since, under prevailing conditions, they represent between $4 and $4.50 per ton of material shipped. Furthermore, a large part of the material sold calls for delivery at some distance from the quarry and few of the bags are returned.

Crude material, air dried (5 to 10 per cent moisture), is shipped in bulk. The brick and blocks sawed from the crude material are so fragile that they must be packed in cartons or crates. These generally hold the equivalent of twenty-five 9-in. straight brick each, and weigh when ready for shipment from 55 to 75 lb. each.

Shipments Bulky and Expensive

Transportation is probably the most serious factor in the marketing of the product. Owing to the very light weight and great bulk of the material, it must carry a high freight rate. The minimum car is twenty tons, and frequently this figure represents the maximum possible load. These factors are a great disadvantage to the western producers, who must ship their material across the continent at great expense in order to reach the large eastern markets. It is probable that the future will see considerable production from known deposits closer to the markets. This will be true particularly of insulation materials, where a considerable reduction in price will more than compensate for a slight inferiority of material.

At the present time the largest single market is for filtration materials, but with the initiation of a cam-

paign of constructive advertising the market for insulating materials is improving rapidly. As engineers become more and more familiar with the correct use and real value of diatomaceous-earth insulation, it is probably that the present producing capacity will be severely taxed. The production of kiln-burned insulating brick made of diatomaceous earth has placed in the hands of the furnace designer an insulating material that resists relatively high temperatures without injury and that has an effective working life equal to or greater than the other materials entering into furnace construction.

Price Range Slight

The prices of diatomaceous earth have been fairly steady during the last three or four years. Crude material is available f.o.b. quarries, Pacific Coast, at from $8 to $12 per ton, depending on quality. Coarse, crude aggregates bring from $15 to $20 per ton. Material suitable for sound-deadening ranges between $25 and $45 per ton in carlots. About the same range of prices holds for the heavier grades of insulating powders, a small tonnage of the lighter powders being sold at from $5 to $10 above this. The very lightest air-floated materials bring as high as $125 per ton in small lots.

Most of the business in filtration materials is on a contract basis and is transacted at a correspondingly lower figure. Contracts are known to have been in existence up to recent date at as low as $17 per ton, but it is understood that renewals are being made at an appreciably higher figure.

Production Closely Controlled

The entire diatomaceous earth industry in America today is dominated by one company. A large part of the present market is due to its untiring efforts at development and advertising. It markets almost entirely through branch offices, of which it has a number scattered throughout the United States.

The available markets, particularly for material for heat insulation, have barely been scratched, and several new companies have taken advantage of known deposits and are entering the field on a competitive basis. Some of the material they are producing is of an excellent quality, particularly the kiln-burned insulating brick, which give promise of replacing the older, inferior, sawed brick, wherever the temperatures are above 400 or 500 deg. F. It is unfortunate both for the producer and the consumer that the custom in the past has been to market diatomaceous earth products under trade names, rather than according to specifications. With new companies entering the field, however, this condition will probably be changed.

Specifications Should Be Definite

Definite specifications, chemical, physical, and microscopic, are one of the most urgent needs of the industry. It is doubtful if any other industrial mineral on the market varies as much in its properties and possible applications as does diatomaceous earth, yet hundreds of tons are sold every day just because it is diatomaceous earth and without regard for the relation between its particular characteristics and the job in hand. A casual examination of the published data on the thermal conductivities of diatomaceous earth will divulge a startling divergence in the results of various observers, much of which can be explained on the basis of variation in the source of the material. A thorough study of diatomaceous earths from various sources in respect to their filtering efficiencies would be of inestimable service to almost every branch of chemical industry. This material gives promise of becoming one of the most important of the industrial earths. It has a potential market almost unlimited in scope, and in many applications is an absolute essential to the efficient commercial operation of certain types of industrial equipment. Competition from foreign producers is highly improbable, as diatomaceous earth is an undesirable cargo for water transportation. Accurate production figures are difficult to obtain, but it is probable that the total for the United States at present is not far from 100,000 tons per year.

Mine Promotion by Selling Options

A form of mine exploitation growing out of the desire of the promoter to escape the "blue-sky" law, is the unit plan, which has been tried in a small way during the last year or two, says C. A. Logan, in the monthly bulletin of the California State Mining Bureau. The following are the main points in one of these projects submitted to the public last summer:

Mr. X secured an option to purchase certain claims, and concluded that $25,000 was needed to finance their operation. He thereupon divided the option into 100 interests, or "units," to be sold at $250 each. On payment of $250 each subscriber was held to be entitled to 1/100 interest (or more, at the same rate) in the option, and in case the option were closed, to a like interest in the property and any production from it. The price of $7,500 for the property to be paid as follows: $1,000 cash on the subscription and sale of 20 units; $1,500 cash on the subscription and sale of 30 units more; the balance to be paid with 30 units at par, at which time a deed would be given for the property. No meeting of unit holders, and no provision in any way for their protection, or for safeguarding the funds or directing the spending of them, was provided for until after the above-mentioned 50 units had all been sold.

The main objection to this plan is that it places too great a responsibility and moral strain upon one man, and there is too much danger of the plan falling through before the unit holders are able even to effect an organization.

Preferred Sizes for Powdered Coal

There is no definite size to which coal must be ground for use in powdered-coal burning plants, although it is recommended, generally, that 95 per cent of the pulverized coal should pass through a sieve with 100 meshes to the inch and 80 to 85 per cent through a sieve with 200 meshes to the inch, states John Blizard, fuel engineer, in Bulletin 217, just issued by the Bureau of Mines. It has been found possible to operate some furnaces with coarser coal, and found necessary for firing open-hearth furnaces to grind the coal more finely. The more finely the coal is ground the more rapidly will it burn, and the more readily will the smaller ash particles pass off with the gas. The power required to pulverize coal increases, however, with the fineness of pulverization.

Improvements in Zinc Milling in the Tri-State District*

Boylan Cones Prove of Wide Application—Canvas Trays Aid Slime Treatment—Belt Conveying Systems Have Revolutionized Tailing Disposal

By Herbert H. Wallower
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IN THE TRI-STATE DISTRICT, where concentration of zinc ores by wet methods is a simple process compared with the treatment of the more complex ores of other sections of the country, there are perhaps no two identical flow sheets, though the general plan of ore treatment is practically the same in all plants. Some operators still adhere to the methods practiced in the early days of the camp, twenty-five years ago, though others have endeavored to place their milling practice on a higher plane.

However, the problems are not quite so simple as they seem on the surface. The character of the ores mined generally throughout the district is variable, certain orebodies being of a decided free-milling character, whereas others are finely impregnated with gangue. The economic point to which it is practicable to pulverize these finely dessiminated ores is difficult to determine, it being necessary in some instances to reduce the material almost to an impalpable dust before there is a complete separation of mineral and gangue. These so-called "chatty" ores are the cause of the divergent flow sheets. Great progress has been made in the last few years in lowering the tailing loss, but much remains to be done.

In this paper I will not attempt to discuss all phases of the metallurgical problem or the various types of flow sheet, but I will speak of the types of apparatus which have materially influenced the arrangement of flow sheets, with a consequent improvement in mill efficiency. One type of apparatus is the Boylan cone classifier, self-contained, automatic in its actuation, requiring no power, comparatively cheap in cost and installation, with maintenance and replacement costs exceedingly low. The cones, of various sizes and shapes, can be adapted for classification to any desired mesh, dewatering and desliming. They have such a variety of uses that they can be employed advantageously throughout the mill.

Cone Mechanism Simple

The mechanism of the cone is based on the principle of platform scales. The cone, usually of a pyramidal shape, is suspended by knife edges from a scale beam. The valve, at the bottom of the cone, with lever arm, is connected to the scale beam by a tierod outside of the cone. Adjustable weights on the scale beam regulate the movement of the cone as material is introduced into it, so that a constant discharge of the desired size can be obtained through the bottom of the cone, with a corresponding control of material in the overflow. With this automatic balancing effect, the cone will adjust itself for any variation in the feed. It functions equally well on feeds ranging from fine sand to 1-in. material.

The most important application of the Boylan cones probably is their use on jigs. Cones placed at the head end of the rougher jigs, acting as deslimers and dewaterers, increase greatly the capacity of the jig itself, and permit a corresponding increase in the jig efficiency. Required jigging water is supplied through the plunger compartment, with a resultant lifting and suction effect of great intensity on the beds, which assists in better cleaning and permits the handling of more material. By means of the head-end cones, practically all sand is placed on the jig, the barren sand finding its way to the surface of the beds, and working toward the tail end of the jig along with the coarse tailing. The cone at the end of the jig functions like the head-end cone, with the exception that it is so weighted to throw over in the overflow the sand of —1-mm. size, containing mineral values, but of no great tonnage. A large tonnage of barren sand is therefore discarded initially to the tailing pile instead of being treated on the sand tables, as was formerly customary.

The Application of the Boylan Cone to the Cleaner Jig

The work of the cleaner jig has been materially improved by the use of the same type of cone at the head end. The desliming effect of the cone removes the float lead which is always a source of trouble on the cleaner. The dewatered feed, as with the rougher, increases the capacity of the jig to the extent that the coarser ore can be cleaned on the first four cells of the jig, allowing the last three cells to act in the capacity of a sand jig, treating the fine sand. Consequently, the usual sand jig is eliminated.

As the sand jig formerly depended for its feed on the cleaner jig tailing and a feed of "chats"[1] drawn from rougher and cleaner, ground in closed circuit to ⅛ in. or less, a modification of the process of handling the "chats" also assists in making the sand jig an unnecessary adjunct. This rearrangement of "chat" grinding consists in returning the cleaner jig tailing, along with the rougher jig "chats," to a 1½- or 2-mm. screen, the oversize of which is sent to the "chat" rolls, ground once, and sent back to the mill feed, while the undersize is sent directly to the mill feed. The object of not adhering to closed-circuit grinding in this instance is to give the rougher jigs another opportunity to clean mineral which has been separated from a "chat" by one passage through the rolls, rather than reducing the richer and coarser "chats" and free mineral released by grinding, to a slime by forcing its constant return through a closed circuit. The subject of "chat" grinding will be referred to a little later in conjunction with coarser grinding of the mill feed.

The flow sheet of the sludge room has also been affected by the introduction of cones. Large cones of the same general type are employed in providing a deslimed and unvarying feed to the sludge room, the live feed cones having for their feed the overflows of all the cones employed in the jig room. The overflow from the live feed cones containing the slime is thickened in a

*A paper presented at the St. Louis meeting of the American Zinc Institute.

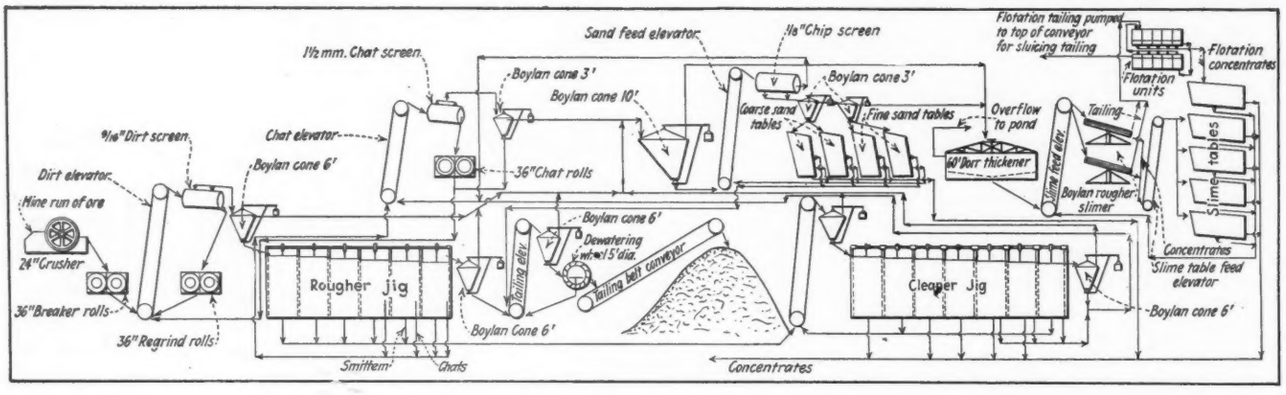
[1]The local term for tailing containing some mineral.

Dorr tank and the thickened slime further treated on tables or by flotation.

The feed to the sludge room through the live feed cones is classified by two smaller cones placed in series, the first of these cones providing a feed for the coarse sand tables and the second for the fine sand tables. This provides a closely classified and deslimed table feed. As mentioned above, the initial discarding of barren sand on the jigs reduces greatly the number of sludge tables required.

Rougher Slimers Constructed of Canvas Trays

Another machine of recent development which increases the efficiency in treating slime is the rougher slimer. This is made up of canvas-covered trays, which, in an horizontal position, catch and retain slime values as the slime feed passes over them. The trays are then automatically tilted, and the enriched slime is washed off, constituting a feed to the slime tables for further dressing. The machine works automatically with no outside power, the actuating device consisting of a water box which, when filled, overbalances the trays and tilts them. As the clear water is discharged from the water box, it washes off the trays, and when the box is empty the trays right themselves. The employment of the rougher slimer is for the purpose of discarding, before tabling, as large a volume as is possible of waste slime, being similar in practice to the discarding of barren sand on the jigs before tabling.



Present flow sheet of mill of Golden Rod Mining & Smelting Co., Tar River, Okla.

Experimental Plant Under Government Supervision

As an evidence of the increasing interest and study of milling problems, an experimental plant has been constructed by one of the larger companies under the supervision of government engineers, who have been studying the metallurgical problems. In this mill, grinding to $\frac{3}{16}$ in. has been resorted to, the object of the coarse grinding being to increase the capacity of the mill, with consequent lower power, grinding, and replacement costs, as well as the prevention of unnecessary sliming and the recovery of more ore in the coarse state. The tailing from the rougher jig is screened to $\frac{1}{4}$-in. The $+\frac{1}{4}$-in. material is treated on a two-cell "chat" jig. This type of jig has one long cell and two plungers. The material is jigged rather slowly, and two products are made, a "chat" concentrate and a clean tailing. The "chat" concentrate is sent to a set of rolls, where it is ground to $\frac{1}{4}$ in., when, together with the $-\frac{1}{4}$-in. material from the rougher jig tailing, it proceeds to a four-cell jig. The tailing from the jig goes to a cone classifier, the discharge of which goes to the tailing pile and the overflow to the sludge mill for further treatment. The "smittem"[2] from this jig returns to the cleaner jig, whereas the "chats," after grinding to $\frac{1}{8}$-in., are sent again to the "chat" jig. This four-cell jig replaces the often-employed secondary rougher and obviates the regrinding of all the tailings to remove a small proportion of mineral from the "chats."

More than ever before in the history of the district, the operators are seeking more efficient methods, not only in the metallurgical treatment of their ores, but in power-saving and labor-saving equipment. Mechanical methods of handling ore underground, improved tramming systems, both underground and on the surface, consisting of the more liberal use of electric locomotives, cable haulageways and skip hoisting, indicate the closer study being given to these costly problems.

The most radical departure from time-honored district practice has been the recent development of the belt conveyor in disposing of the tailing. Its application has proved of undoubted advantage both for small mines and larger plants. Within the last few months, many conveyors have been installed, proving that an economic principle, once established, finds ready acceptance among the operators. The principle of the conveyor is not a new one in the field, though its successful operation had never been conclusive by reason of the failure of efficient dewatering of the tailing before placing it on the belt. This problem has been overcome by employing a dewatering wheel of small diameter, equipped with cup-shaped blades between the outside flanges of the wheel. A screen jacket is placed around the wheel, underneath the blades. As the wheel revolves, the cups pick up the wet tailing from underneath, and as the cups travel toward the top, their load of tailing is deposited on the screen jacket. The wheel revolves slowly, so that there is every possibility to dewater thoroughly before the tailing is discharged from the wheel to the chute which feeds the belt. A cone is placed at the head of the wheel to effect partial dewatering and to afford a safeguard from rushes of water in starting the mill. Another method of dewatering efficiently is by means of a belt drag on an inclined plane, which drags the tailing above the water level and discharges it onto the belt.

A 250-ft. conveyor at an inclination of 20 deg. will

[2]The local term for the middling from a jig.

replace two "dummy" elevators, a mill tailing elevator, and a sand tailing elevator, and its cost of operation in power is approximately one-third of that required by the elevators. The conveyor belt will exceed the life of the wet-cup belt by two and one-half or three complete replacements. The labor saving in attendance and maintenance is large. In one instance, three "dummy" elevators, a high mill elevator, and a sand elevator, if replaced by a 450-ft. belt conveyor with a life conservatively estimated at four years, would effect a net saving of over $45,000, including the cost and installation of the conveyor equipment.

Sluicing of the tailing at the top of the conveyor is effected by pumping the slime tailing, which takes but little additional power. The cost of the conveyor complete compares favorably with the cost of a "dummy" elevator, and several operators are installing conveyors purely on the basis of economy in operation over the requirements of a new "dummy" elevator.

The cheapest equipment is often the most expensive in the long run. This is especially true of pumping, and many mills are installing high-efficiency pumps, at greater first cost but with an operating economy which quickly retires the investment.

The willingness on the part of the operator generally to recognize, first of all, the need of improved methods, and secondly to overcome the antiquated methods, along with the generous spirit of helping one another, has made possible the carrying out of new and improved methods in the Tri-State field.

Design of Furnaces for Burning Powdered Coal

Furnaces in which powdered coal is to burn must be large enough, and be correctly shaped, so that the coal may burn completely without impinging on the brickwork, and must be provided with facilities for removing the ash, states Bulletin 217, just published by the Bureau of Mines. If the furnace is correctly designed, about 3 B.t.u. per second may be liberated per cubic foot of combustion space. This rate of combustion is sometimes exceeded, but if it is much exceeded the coal will not be burned completely.

In many furnaces the temperature is so high that the ash fuses, and on settling in the furnace collects in a continuous mass. It has become expedient in some furnaces to cool the ash before settling and so prevent it collecting in a continuous mass, though generally this is not done, and the ash collects either on the hearth, whence it is removed when the furnace shuts down, or it is removed as a liquid slag. The ash that does not settle in the furnace goes off with the gases, and care must be taken to see that it may not be deposited in the flues and so impede the draft.

When a furnace previously heated by coal burned on a grate, gas, or oil is to be transformed into a powdered-coal fired furnace, the furnace may or may not have to be modified in design to suit powdered coal. Except for boiler furnaces, radical alteration of design is unusual. At most, the change generally consists in enlarging the furnace. But no furnace should be fired with powdered coal without the advice of experienced engineers, who will either approve the application of powdered coal to the furnace as it exists or carefully redesign it so that it may be economically operated with powdered coal, using the best means of disposing of the ash.

Nipissing's Silver Costs

The Nipissing Mining Co., of Cobalt, Ontario, is a large silver producer. During 1922 it produced 3,423,115 oz., having a net value of $2,510,570.93. The costs of production are given in detail in the annual report of the company for 1922, from which the following data have been taken:

Nipissing Mining Co. Cost of Producing Silver

Based on Production of 3,423,114.80 Oz. and 82,025 Tons

	Per Ton Ore	Per Oz. Silver, Cents
Diamond drilling	$.385	.921
Exploration	1.532	3.671
Development	1.263	3.027
Stoping	1.444	3.461
Hauling dumps	.086	.207
Assaying and engineering	.158	.380
Loading residue	.007	.016
Tailing disposal	−.008	−.019
Administration and office	.621	1.488
Camp maintenance	.051	.122
Insurance and taxes	1.539	3.689
General and legal	.245	.586
High-grade mill	1.662	3.983
Low-grade mill	4.189	10.037
Depreciation	.397	.951
Marketing product	.267	.639
Corporation, New York office and traveling	.237	.568
	$14.075	33.727
Less rents, exchange, and miscellaneous income	.329	.789
Total cost of production	$13.746	32.938

The results of the stamp-mill operations are summarized as follows:

Low-Grade Mill

	Tons	Assay	Ounces
Ore treated	82,025	44.01	3,609,757
Recovered in products			
Precipitate	35	24,683	866,358
Coarse concentrate	1,796	1,338	2,403,030
Fine concentrate	261	450	117,452
Total recovery	.....	.....	3,386,840

Average tailing, 2.77 oz. Recovery, 93.82 per cent.

Forty stamps ran 290 days and 19 hours, or 79.67 per cent of possible running time, and crushed 282.1 tons per day, or 7.053 tons per stamp per day. The tons and ounces treated were more than in any previous year. The cost per ton was 41c. lower than in 1921, notwithstanding there were no material decreases in the market cost of supplies.

Low-Grade Mill Costs

Based on 82,025 Tons Milled

	Cost per Ton
73 Crushing Plant	$0.009
Aerial tram	0.064
Surface tram	0.109
Crushing and elevating	0.122
Batteries	0.284
Tube mills	0.726
Concentration	0.279
Cyanide treatment	1.641
Filtering	0.234
Precipitation	0.192
Refining	0.070
Heating	0.264
Water service	0.054
Residue dam	0.018
Research	0.040
	$4.189

Cost per ton: Labor, $1.051; supplies, $2.252; power, $0.670; shops, $0.238; credits, $0.022. Total, $4.189.

Cost of Chemicals and Main Supplies at Low-Grade Mill

	Total Pounds	Cost per Pound	Pounds per Ton	Cost per Ton
Sodium cyanide	527,523	$0.1779	6.430	$1.1443
Soda ash	525,200	0.0259	6.403	0.1659
Lime	462,300	0.0081	5.636	0.0462
Pebbles	229,200	0.0153	2.794	0.0429
Sodium sulphide	70,338	0.0464	0.858	0.0398
Caustic soda	34,560	0.0474	0.421	0.0201
Iron balls, 1¼ in.	3,257	0.0399	0.039	0.0542
Aluminum	3,250	0.2281	0.039	0.0091
Hydrochloric acid	5,452	0.0805	0.066	0.0053
Steam coal	2,453,000	0.0055	29.905	0.1635
				$1.6913

Iron Ore in the Dutch East Indies

Large Deposit of Limonitic Clay—Extent Proved by Drilling—Geological Features —Hydro-Electric Energy Available—Charcoal, the Only Feasible Fuel, Is Obtainable—Favorable Results of Metallurgical Research

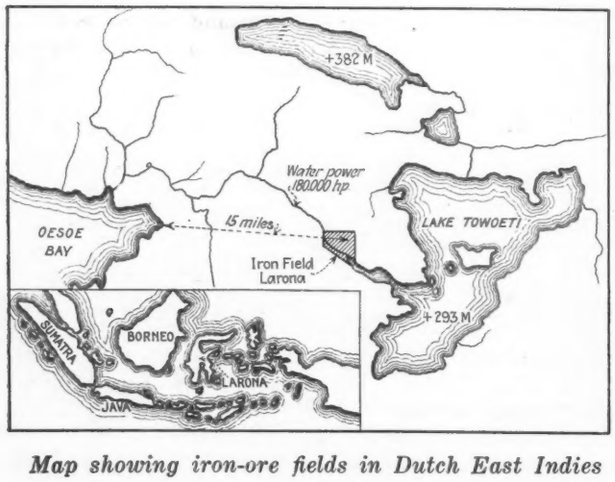
BY ALEX. L. TER BRAAKE
Bureau of Mines, Batavia, Dutch East Indies

AMONG the readers of this paper it is probable that few have a comprehensive understanding of the mining possibilities in the Dutch East Indies, that large archipelago, situated between Australia and the Malay Peninsula, with a population of nearly 50,000,000. Except for the well-known oil fields of Borneo, Sumatra, and Java, and the Banka and Billiton tin mines, little has been published about mineral deposits in this country, in a language other than Dutch. Herewith is a brief description of the huge iron-ore fields in Celebes, discovered two years or so ago, and of the possibilities of developing an iron and steel industry.

The principal part of the lake district in central Celebes (see the map) consists of basic rocks of the peridotite family, principally harzburgite and dunite, which have been altered to serpentine. Part of this serpentine is covered by limestone, and the weathered products of both have filled the depressions. The serpentines are decomposed by leaching of the magnesia and part of the silica, and the result is a red-brown earthy clay, which covers most of the country. At several places conditions have been exceptionally favorable to this leaching process. Alumina, chromite, and iron oxide are the only constituents which have resisted the action, and the product left behind is lateritic iron ore, similar to the ores of Cuba (Mayari) and the Philippines.

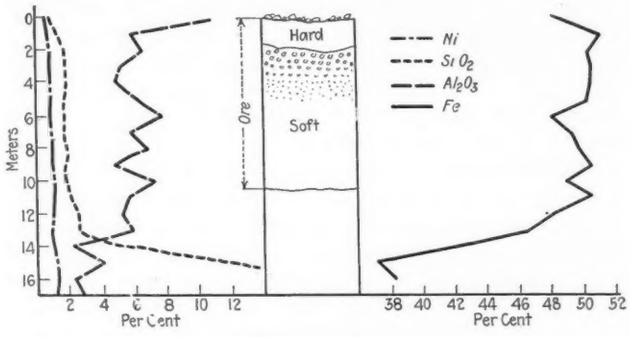
ORE IS A LIMONITIC CLAY

In several places huge masses of this peculiar ore are exposed, covered only by extremely sparse vegetation. The principal deposit is the one near Larona. It extends over an area of more than 15,000,000 sq.m. (3,800 acres). The bulk of the ore consists of a limonitic clay, varying in color from yellow at the bottom to dark brown at the top, and part of this clay is covered by a solid mass of hard dark-brown and black ore. The thickness of this hard ore varies up to 7 ft., whereas the average depth of the entire deposit is 40 ft. Systematic drilling has opened up 370,000,000 tons of soft ore and 15,000,000 tons of hard ore, and still larger masses of both types are available.



Map showing iron-ore fields in Dutch East Indies

The diagram given shows a typical section through one of the drill holes, with a graphic representation



Typical section of deposit, showing analysis of ore

of the iron, nickel, silica, and alumina contents varying with the depth. Going downward, nickel and silica increase slightly, iron is nearly constant, and alumina is lower, but the variations are small. At 11 m. (37 ft.), however, the iron content decreases rapidly, whereas the silica grows higher. At greater depth serpentine is found.

A typical analysis of the ore, dried at 105 deg. C., is as follows:

Constituent	Per Cent	Constituent	Per Cent
Fe_2O_3	68.90	CaO	0.74
FeO	1.67	MgO	0.07
Fe	49.36	NiO	0.39
MnO	1.04	Cr_2O_3	2.48
Mn	0.81	P_2O_5	0.094
SiO_2	2.04	S	0.096
Al_2O_3	5.04	Loss on ignition	18.24

The soft ore contains a considerable amount of moisture, varying from 25 to 30 per cent.

The Larona field is situated at 960 ft. above sea level, and the distance from the coast is 15 miles. A ropeway is proposed for carrying the ore to the coast, as railway construction would meet with considerable difficulties, on account of the roughness of the country.

WATER POWER IS AVAILABLE

In the immediate vicinity of the ore deposit about 18,000 hp. of hydro-energy is available. This is almost constant during the year, being regulated by three lakes, thereby assuring electric power at exceptionally low cost. The country possesses large forests consisting of a great variety of woods. These forests are situated inland as well as near the coast. The moisture of the green wood is comparatively low, and of the wood seasoned for a few months only 10 to 12 per cent. Experience in adjacent islands shows that good charcoal may be produced from this wood. Metallurgical coke is

not available in the colony; when imported the price is prohibitive.

An extensive investigation was made by the Colonial Government of the Dutch East Indies as to the possibility of using the native ores for the manufacture of iron and steel. Several European and American experts have been asked to give their opinion, and the replies were unanimously favorable. Large-scale experiments were run in an electric shaft furnace of the Elektrometall type in Sweden, in which country this type of furnace has proved to be a success. A rather unusual slag was used, containing 45 to 50 per cent Al_2O_3, 20 per cent SiO_2, and 25 to 30 per cent CaO + MgO. This slag was free-running at the temperature of the furnace and gave no difficulties. Power totaling 2,550 kw.-hr. and 20 hectoliters (1 hectoliter = 2 bushels 3.35 pecks) of charcoal were used, and 200 kg. of slag was produced per ton of iron. The furnace had to be kept rather hot, in order to reduce the chromium, which did not readily enter the slag. Consequently, the iron was high in silicon. A typical analysis follows:

Element	Per Cent	Element	Per Cent
Si	1.3	S	0.10
Cr	4.0	P	0.07
C	3.7	Mn	0.5
Ni	0.5		

COMBINATION OF BESSEMER AND ELECTRIC FURNACE

For converting this pig iron to steel, the duplex process is proposed, because it is the only successful way in which chromium can be oxidized and removed from the iron, without causing difficulties with chromium oxide in the slag. A combination of bessemer converter and electric steel furnace will be needed.

Though the process as outlined and the equipment necessary will make a plant with many unusual features, all steps of the process, from the pig iron to the finished product, have actually been performed successfully.

As a desirable size for the plant, an installation has been considered with an annual output of 50,000 tons of steel rails, approximately covering the present yearly consumption of the Netherlands East Indian Colonies. Conditions, however, are excellent for the production of special chromium-nickel steels, both chromium and nickel ores being available in the immediate vicinity of the proposed plant. The Netherlands Colonial Government originally intended to build this plant and start it as a public enterprise; the economic world situation, however, forced the authorities to economize, and recently it has been decided to encourage the investment of private capital for development, either domestic or foreign.

Large Gold Nuggets From Small Veins in California

In a rugged, out-of-the-way region on the ocean side of the Coast Ranges, in Monterey County, Calif., gold nuggets have been found of such size as to suggest that this was once a favorite retreat of the proverbial goose that laid the golden eggs. Matter-of-fact prospectors, however, have sought to find the veins from which such masses of gold, loosened by the weather, were washed into the stream beds. Their search has not been successful, and J. M. Hill, a geologist of the Department of the Interior, in a report just published suggests that the nuggets came from rich superficial pockets in very small veins, and that no large and rich deposits are likely to be found by deep mining. The Coast Ranges of California, unlike the Sierra Nevada, are not rich in gold, and the occurrence of these large nuggets is exceptional and illustrates the fact, known to many prospectors, that the discovery of a few large nuggets does not necessarily indicate the existence of a rich deposit of gold ore in place.

Mr. Hill's report, entitled "The Los Burros District, Monterey County, California," is published as Bulletin 735-J and can be obtained on application to the Director of the Geological Survey, Washington, D. C.

Cost of Steam-Shovel and Underground Mining of Nevada Consolidated

The Nevada Consolidated Copper Mining Co. at Ruth, Nev., is conducting both open cut and underground mining operations. The report of operations of the company for 1922 gives the following detailed and comparative costs of both types of mining. Of the ore mined during 1922, 55.5 per cent was from the pits and 44.5 per cent from the Ruth underground mine workings.

Steam-shovel mining costs of concentrating ores, exclusive of depreciation and federal, state and local taxes, but including all other overhead expense, were as shown hereunder:

	Cents per Ton Ore			Cents per Cu.Yd. Capping		
	1922	1921	1920	1922	1921	1920
Drilling and blasting	3.78	6.45	6.14	9.50	11.26	8.78
Steam shovel operations	2.73	2.77	3.04	6.24	5.78	5.90
Locomotive tramming	4.44	7.69	8.61	16.23	18.23	18.75
General pit expense	3.71	1.78	2.50	2.64	1.25	.96
Miscellaneous	7.54	9.42	9.81	8.79	4.71	6.08
Totals	22.20	28.11	30.10	43.40	41.23	40.47

The above mining costs do not include 40c. per ton of ore mined, which is charged regularly to cover prepaid stripping expense.

Ruth porphyry underground mining costs of concentrating ores, exclusive of depreciation and federal, state and local taxes, but including all other overhead expense, were as follows:

	Cents per Ton		
	1922	1921	1920
Branch raises and sublevels	24.34	22.35	24.12
Undercutting and caving	12.14	18.05	17.94
Tramming expense	6.70	6.23	7.94
Hoisting expense	4.82	4.60	6.11
General underground upkeep	26.34	18.81	24.36
General mine expense	5.60	7.02	7.08
Miscel'..neous	8.80	8.63	9.65
Totals	88.74	85.69	97.20

Ruth sedimentary ore underground mining costs for the year 1922, exclusive of depreciation and federal, state and local taxes, but including all other overhead expense, are shown in the following table:

	Per Ton
Square set mining	$2.352
Tramming expense	.107
Hoisting expense	.116
General underground upkeep	.350
General mine expense	.273
Miscellaneous	.360
Total	$3.558

All mining and overburden removal costs for the year 1922 were adversely affected through expensive preparations for resumption of production early in April, following a year of absolute suspension of operations, and also in July by an almost complete shutdown because of the suspension which was caused by the loss of the concentrator by fire.

THE PETROLEUM INDUSTRY

Oil Prospecting in Tasmania

Several Victorian and South Australian companies and syndicates are actively engaged in developing and testing the Mersey Valley oil shale area and its extensions near Latrobe, Tasmania. The Southern Cross Motor Fuels, Ltd., of Melbourne, secured the old Railton-Latrobe Co.'s property about two years ago and has been experimenting with an improved retort, which is said to have worked satisfactorily, and contemplate constructing fourteen more. Each retort will have a capacity of 30 tons of shale per twenty-four hours. The company has a large body of shale opened up by two tunnels. The Adelaide Oil Exploration Co. has been extensively boring, and has located a large area of shale at Native Plain, east of Railton. Shale has been proved to exist from Latrobe on the north to Minnow and Quamby Bluff in the south, a distance of about 30 miles, and from west of the Don River to Rubicon, a breadth of about 10 miles, or an area of 300 square miles.

The Mersey Valley Oil Co. recently started its oil drilling plant which has been manufactured on the lines of American rigs by the Goldfields Diamond Drilling Co. whose managing director recently returned from a visit to the United States. This plant will sink a hole to 5,000 ft. if required, but E. de Hautpick "the Russian oil geologist" states they expect to strike oil between 2,000 and 3,000 ft. That being so, if oil does exist it should be proved before the end of the present year. Mr. Hautpick has reported favorably on oil prospects in many parts of Australia, but apparently he pins his faith to the Latrobe district of Tasmania. At the official opening of the Mersey Co.'s plant he said among other things:

"The Permo-Carboniferous beds at the Mersey Valley may be regarded as a potential reservoir. They are both marine and terrestrial; they are charged plentifully with marine fossils, the organic remains, with the special type of carbonaceous residue of vegetation as oil shale, and the special type of coals which we term sapropelites. These beds consist of alternating impervious (mudstone), and porous sandstone, indicating lagoonal conditions, which connected with oil generation. Oil shale occurs in the Mersey Valley on a great scale, embracing the Latrobe, Minnow, and Deloraine districts. As far as can be judged only by outcrops, this extensive development of oil shale represents a quantity of many million tons. What is this shale? Its analysis shows volatile hydro-carbon 22 per cent, fixed carbon 5½ per cent, and sulphur about 1 per cent. As you know it presents the appearance of a brownish-gray slate, rather than that of any kind of fuel, yet it burns with a smoky flame freely, with a very offensive smell. By distillation in the retort, we can obtain from the oil shale 40 gallons of crude oil to a ton (nearest to typical petroleum generated by Nature). Today oil geologists agree that the same kind of organic rocks deposited at the depth is the mother substance for the liquid oil. The impervious, thick cover gives pressure and sufficient heat to distillate oil from the shale as we do it in the retort. . . . We have in this part of the Mersey basin, where we start our deep bore today, the fulfilment of all the essential conditions to the occurrence of oil in commercial quantities established by the modern method of geological engineering, namely:

"(1) Suitable sedimentary rock of Permo-Carboniferous and tertiary age.

"(2) Sufficiency of organic material, oil shale, and sapropeletic coals, presence of oil seepages, and gas mounds.

"(3) The moderate disturbances of the rocks with favorable carbon ratios, indicating the liquid oil is still underground.

"(4) The presence of the sufficient thickness of sedimentary rocks with a good cover for oil basin.

"(5) Saturation of sedimentary rocks with salt water, which is observed in all oilfields.

"(6) Suitable artesian water conditions for the accumulation of oil.

"(7) And suitable structural features of a domelike elevation, under our deep bore, where is accumulated the largest part of oil migrated to this depression."

Exploring for Oil at Bilbao, Spain

There are at present eight companies engaged in exploration for oil in the Bilbao district, according to information published by the official chamber of mines at Bilbao, and reforwarded to Washington by Consul H. M. Wolcott. The denouncements of these companies in the Spanish Basque Provinces alone of the Bilbao district cover many thousand acres of lands which have been favorably reported upon by the companies' geologists. A number of borings have been made which have given favorable indications, but no results of a definite character have as yet been achieved. One company of American affiliation and one of British origin are now drilling in the Provinces of Navarra and Logrono. A Spanish corporation which has received a subsidy from the Spanish Government of 128,930 pesetas will renew operations at an early date in the Province of Burgos. As Spain is now dependent on the outside world for its supply of petroleum and products, the operations of the oil-exploration companies are naturally watched with the greatest interest.

Petroleum Import Figures Show Loss

Imports of liquid petroleum products for March, 1923, show a 28 per cent gain over the February receipts, but a loss of 33 per cent as compared with March, 1922, according to figures issued by the Department of Commerce. Crude petroleum, the chief item imported, amounted to about 85 per cent of the liquid petroleum products received during the month. The quarterly total through March was 1,132,076,105 gal. of crude and refined products as compared with 1,682,144,742 gal. received during the first quarter of last year.

Oil Mining in Germany

The process of extracting oil by means of shafts or pits sunk to the oil sands is now being used in a field at Wietze near Hanover, Germany, according to the recent annual report of the Deutsche Erdoel Aktiensgesellschaft. The oil is obtained by means of a washing process applied after the sand has been hoisted.

Oil Prospecting in Australia

The oil prospecting fever which reached its highest point a few months ago in Queensland has greatly subsided, as well as in other parts of Australia. In this state only two companies are now carrying on active operations, but these are working on a scientific and systematic plan and are about to install boring plants to test thoroughly the areas held by them. Of the numerous holes that have been drilled in the commonwealth, nearly 99 per cent have given favorable indications, or traces, of oil, but as yet there has been no strike of payable oil—a result due to the fact that sedimentary rocks often contain traces of oily or waxy substances which are not necessarily favorable indications. A hole started at Tewantin, on the Queensland coast a hundred miles or so north of Brisbane, met its first trouble at a depth of 142 ft. in the form of a strong flow of artesian water, coming up at the rate of 80,000 gal. a day. This is the trouble that finally killed the government hole at Roma, where, according to Duncan Milsom, the oil sands immediately around the town are ruined by flooding.

Negotiations have been completed by the government for an examination of the Northern Territory and northern Australia, which doubtless includes the northern part of Queensland, by Dr. Arthur Wade. He will report on the oil-bearing potentialities of the tropical north generally. Doctor Wade, who is now in Madagascar, was chosen for this duty on the advice of Prof. Edgeworth David, of the Sydney University, whose recommendation was made after consultation with other geologists. It is expected that Doctor Wade will arrive before July, to allow his inspection to be made before the wet season.

All the machinery and a tractor ordered for the Elcho Island Naphtha Petroleum Oil Co. arrived at Port Darwin, Northern Territory, recently.

New Oil and Gas Map of California

A map showing the oil and gas fields of California, just issued by the U. S. Geological Survey, is of special interest. The map, which measures 44 by 48 in. and is on the scale of 1,506,880, or 8 miles to the inch, shows the oil and gas fields in green, the pipe lines and refineries in violet, the cities, towns, and railroads in gray, and the streams in blue. It is one of a series showing the oil and gas fields of different states already published or being prepared for publication by the Survey. Maps of Louisiana, Oklahoma, Kansas, Illinois, Pennsylvania, Wyoming, West Virginia, Kentucky, and California have already been published, and may be obtained from the Director at Washington, D. C., at 50c. a copy.

Oil Regulations Issued

Operating regulations to govern the production of oil and gas on the leased public lands of the United States, as amended March 3, 1923, have been issued by the U. S. Bureau of Mines, Washington, D. C. The regulations contain information regarding the powers and duties of the supervisor and deputy supervisors of the Bureau of Mines staff who have technical supervision of the operation of oil- and gas-producing properties on public lands. The requirements for lessees of such properties are given in the pamphlet, which also contains information as to oil, natural gas and gasoline royalties.

American Shale Industry Should Study Scotch Methods

Practically the only commercial oil shale industry in the world at the present time is that in Scotland. Other shale-oil industries have either shut down or are operating upon too small a scale to be commercially important. Martin J. Gavin points out in Bulletin 210 of the Bureau of Mines how shale-oil projects in the United States may benefit through a knowledge of the successful commercial practices that have been developed in Scotland. That country has been treating oil shales in a commercial way for over sixty years. The Scotch retort, and retorting and refining procedure have been undergoing improvements for over fifty years, and have changed little in the past fifteen years. This evolution took place under extremely practical conditions, especially as the shale operators were under the pressure of severe foreign competition. It is evident, therefore, that the present retort is the best apparatus the Scotch operators know of in which to treat their particular shale under their particular conditions. It seems equally evident that the United States, in which an oil-shale industry is just beginning, should not fail to take advantage of the knowledge gained during the many years of Scotch practice, and should endeavor to avoid the mistakes made in the early stages of the industry in Scotland. This is said with full realization that shales and conditions in the two countries are dissimilar. Scotch knowledge and practice should be applied and tried in this country as far as they can be applied successfully, and from this stage the experience of American investigators should guide.

Hard Times for Incompetents

Incompetent Indians of the Osage tribe of Oklahoma are to continue to receive only $4,000 a year of their oil royalties with an extra allowance of $2,000 for each minor child, according to a decision made by the Court of Appeals of the District of Columbia in a suit filed by the chief of the Osages, against the Secretary of the Interior. The remainder of their funds is to be invested in Government and State securities or in banks to their credit to be held until the minors reach twenty-one years of age. Each Indian's share of royalties and bonuses for 1922 for the tribal oil lands amounted to $11,700.

Study Sands in Pittsburgh Quadrangle

A paper by M. E. Johnson, issued by the Pennsylvania Geological Survey, summarizes the results of a study to determine the depth, thickness and character of the oil and gas sands encountered in wells drilled in the city of Pittsburgh, and in Plum, Penn, Patton, Wilkins, Braddock, North Versailles, Mifflin, and Baldwin townships in Allegheny County. Although this area has been thoroughly punctured with drill-holes, and the depths to the producing sands have long been well known, little effort has been made to correlate the different sands or to determine how they change in short distances. The author collected and studied all obtainable records of wells drilled in this area and presents his findings in the paper, which is known as Bulletin 73. The correlations made are based on all the data at present available and are said by Mr. Johnson to be correct within the area studied.

New Books

"Elements of Mining" Is Revised

Elements of Mining. By George J. Young. 2d ed. McGraw-Hill Book Co., New York. Price $6.

George J. Young did a splendid piece of work for mining students in college and in the field, when he published in 1916 the important part of his notes and lectures in readable form in "Elements of Mining." A second edition has recently been published, with operations in the field brought up to date. This book brings out in a concise manner the important features of mining operations, mining methods and business in a particularly practical manner. Prospecting, both on the surface and underground, is first taken up briefly and concisely—almost too briefly for important preliminary investigation. This is followed by the excellent chapter on Boring, with a compact description and good illustrations of machines and work of Churn Drills, Diamond Drills and other methods of investigation. The working features and costs on this and all parts of the business are brought out strongly, presenting to the student the business factor of this class of engineering work.

One thing to which students should give careful consideration as a chief element in mining operations is drilling and breaking ground, whatever method of mining be adopted. The chapters on these subjects bring out not only a very clear description of the machines for drilling and explosives used, but also the features to which operators now give more and more attention, namely, the hardness of rock encountered; the character of drill steel; the cutting speed of steel and drills per shift; standard rounds to be drilled for various classes of rock; all most important in attaining efficiency and higher grade work. The comparative strength of explosives; the amount of explosives required; the amount of ground which may be broken; all with costs, are clearly brought out. A careful study and investigation of these chapters will give the student or anyone a good basis of the elements or principles of operation in mining. The book has a good deal of meat in these few chapters.

Development and underground methods of mining are concisely but rather too briefly covered in the more simple or standard methods of development and of stoping. They give, however, good examples of the day's work in the different operations; the costs and the results obtained. Improvement could be made in fuller explanation and examples of the varied methods of underground mining, and more particularly of operations in medium sized veins or beds. Support of mine workings is fully and carefully written. The illustrations in these chapters are particularly good, and these, too, add an important and necessary instruction on good operations. Surface mining, both open-cut and alluvial, is covered thoroughly. These are considered in a practical manner, with good description of operations; with excellent papers of costs and with the results and profits obtained. The engineering features of Mining, Transportation and Hoisting, Mine Drainage, and Ventilation are taken up thoroughly with good illustrations and examples, particularly on Transportation. The business end of mining is brought out concisely in a chapter on Mine Accounting. Although this is an important subject for instruction to mining students—for mining is a business quite as much as a technical process—the short account in this volume is hardly in keeping with the description of technical operations. It is to be wished that Mr. Young or someone would write a good book on accounting for mining and metallurgical students. This subject would be sufficient for a separate volume.

Altogether Mr. Young's book on the elements of mining is a most valuable addition to literature on this subject; clearly and concisely written; up-to-date, with good, practical examples, and put together in an attractive and readable form.

R. M. RAYMOND.

Chemical Analysis

Elementary Qualitative Analysis. By Frederick C. Reeve. D. Van Nostrand Co., New York. Price, $1.50.

This little manual is intended as a laboratory guide for students in elementary qualitative analysis. The method followed is that of a series of experiments by means of which the student is made familiar with the separations of the more common metals into groups and the identification of the several members of each group. The ordinary tests for the identification of the common acid radicals are also given, and a brief outline of the Theory of Ionization gives the student a fair working knowledge of this theory, which is so important in the study of analytical chemistry. A useful feature of the book is a complete list of apparatus and reagents required for the whole series of experiments.

R. M. COLEMAN.

Coal Utilization in Britain

Low Temperature Carbonization of Bituminous Coal. By Andrew McCulloch and Neville Simpkin. H. F. & G. Witherby, 326, High Holborn, London, W.C. 1, England. Price, 18 sh.

In this volume the present oftentimes inefficient use of coal is discussed and the means by which it may be more efficiently utilized are described. Though a thoroughly British book, it contains much information that should be of value to readers in this country who are interested in fuel consumption.

Technical Papers

Pennsylvania Ore Deposits — The Bureau of Topographic and Geological Survey, Harrisburg, Pa., has issued Bulletin No. 71, "Copper Ores in Pennsylvania, pp. 8; Bulletin 74, "Chromite in Pennsylvania," pp. 7; and Bulletin 77, "Gold in Pennsylvania," pp. 13. Copper minerals are scarce, the gold deposits are principally mineralogical curiosities, but it is thought that profitable orebodies of chromite may yet exist undiscovered in addition to those which have been largely worked out. Would-be investors are warned about subscribing to mining ventures in the state without full investigation. In this connection, we recently sat next to a New York schoolgirl who was studying a book in which nickel was given as one of the three natural products for which the state of Pennsylvania was noted. We regret that we were unable to see the name of the author of the book in question. We believe there *was* a little nickel taken out of the old Gap mine, some forty or fifty years ago.

Pulverized Coal—Bulletin 217 of the U. S. Bureau of Mines, Washington, D. C., pp. 127, obtainable on request, is entitled "Preparation, Transportation, and Combustion of Powdered Coal." Much information, illustrated by photographs and diagrams, is given, descriptive of the various types of equipment. The bulletin is similar to one issued a few years ago by the Canadian Department of Mines; in fact, this edition is published through the courtesy of that organization. The author is John Blizard.

Economics of Gold—In *Commerce Monthly* for June (National Bank of Commerce, New York City; free on request) is an eleven-page discussion of "The Problem of Our Excess Gold."

Colorado Mining—The Bureau of Mines of the State of Colorado (State Capitol, Denver, Colo.; price free) has issued its annual report for 1922, pp. 58. The report discusses general conditions at the mines during the year, gives detailed accident statistics, and includes a list of all operating mines of the state, with the names and addresses of the operators, and the kind of products.

Los Burros District, California—Bulletin 735-J of the U. S. Geological Survey, Washington, D. C., pp. 7, contains brief descriptive notes of the ore deposits of the Los Burros district, Monterey County, Calif. Obtainable free.

Premier Gold Mine—In the *Mining Magazine* for May is an article on the history and development of the Premier Gold Mine in British Columbia, the development of the surrounding Salmon-Bear River district also being included. The article is concluded in the June issue. (Salisbury House, London Wall, London, E. C. 2, England; price 1 sh. each.)

SOCIETIES, ADDRESSES, AND REPORTS

Ithaca Convention Draws Engineering Educators

Over 300 Attend S. P. E. E. Annual Meeting— Discussion Centers on Question of Training for Leadership

TRAINING engineers for leadership in industry and public service was the major topic for discussion at the annual convention of the Society for the Promotion of Engineering Education, which was held in Ithaca, N. Y., on June 20 and 22, over 300 engineering educators attending. In discussing this subject, Dean Dexter S. Kimball said that twenty years ago the idea of a course for leadership training was startling but that now the topic was one of prime interest and importance. The business world, according to Dean Kimball, now desires and admires the engineering way of doing things and in so far as design, operation and management of industry are concerned the engineer will reign supreme in a short time. The engineer has the problem of leadership forced upon his attention because they have brought into the world new methods, little understood by the people at large but so powerful that the public thinks they can solve many of the present problems of civilization. The engineer has developed the utilitarian application of the scientific method of attack.

Any changes that are made in engineering education must not occur in a way that will undermine the fundamental training that has produced the engineering mind, according to the Dean. If fundamentals of science, mathematics, chemistry and physics are neglected in training for leadership, failure will ensue. Leadership today is largely legal in that the military dictator has passed and the world is largely governed by the modified past experiences of the races. But modern industry is new and has no past precedents to draw upon, no background of experience. Therefore hope for solving the problems of the industrial epoch lies in the industrially intelligent group of men. The intelligent leader must understand mass production, finance, management and human relations. The era has now dawned for setting up universal well-being as the industrial ideal instead of private profits for individuals, corporations, states or nations. The engineer is fitted for this task in many respects because he has a method of attack and tools for conquering all physical handicaps. He has weaknesses, however, in that he, in common with others, cannot read, write or spell correctly; he is not interested in people or things outside of his work; he dreads routine and he has no historical background. All of these defects can be bettered and the fundamental requirement for leadership is historical background. This historical background should be given by competent men and should be given in the course if vision is desired in the output of the schools.

Following Dean Kimball's address, President Charles F. Scott presented the report of the board of investigation and co-ordination appointed last year to ascertain the possibility of obtaining funds for carrying on educational research in the engineering schools and for outlining the type of research that would be most beneficial.

Research Should Be Conducted by Schools, Committee Says

The report stated that the basic principle determined upon was for the engineering schools to do the research work under the direction of the board and a Director to be appointed. The definite objectives in view were to determine the objects of engineering education, the best methods for obtaining the objectives and the modification in curricula and teaching personnel and equipment needed to improve engineering education. To do the work $108,000 was needed. A letter from Dr. H. S. Pritchett of the Carnegie Corporation heartily endorsed the proposal and stated that the project had been recommended to several foundations with almost assured acceptance. It was hoped to have the Director appointed immediately and each school was asked to immediately appoint a faculty committee to co-operate with the board and carry on the work. Prof. L. A. Hopkins read a paper by Prof. J. R. Nelson which gave an example of some educational research work carried out at the University of Michigan with splendid results. The report was accepted by the society and the project endorsed.

On Thursday morning T. H. MacDonald, chief of the Bureau of Public Roads, Washington, D. C., presented a paper on "The Engineer as a Leader in Public Service." He stated that the public does not rapidly impose authority on any class or group of people but waits for demonstrations of competency. Measurement of the amount of engineering leadership is best found by studying the degree of authority they now exercise.

E. H. Lee, vice-president of the Chicago & Northern Indiana R.R. Co., spoke of the engineer as a leader in transportation. Good service and good publicity are recognized as fundamental requirements by railroad executives, he said. Real leadership is necessary and education should aid men of brain and ability to attain proficiency. Men should be classified into leaders and craftsmen and the former should have a longer and better training. The others should have a shorter training. The leaders must have the widest possible horizon and knowledge of how to sell himself and his industry to the public.

"The Engineer as a Leader in Industry," was the topic of O. S. Lyford of the National Industrial Conference Board. His paper was the result of the work of a joint conference committee to determine the place and leadership of the engineer in industry. Engineers should be leaders because they have a method of attack and a scientific mind, and industry counts as fundamental the underlying scientific training of the engineers. In the report, three questions are presented:

1. Does industry need more or fewer engineers than now available?
2. What kind of education should they have?
3. What is the responsibility of the industry in their work?

The final answer can be had only through co-operative effort. History of industry shows that big problems confront industry. One big factor will be the keen competition of European countries when they emerge from the present political, financial and industrial slump. Both external and internal relations in industry will force American employers to exercise the highest skill to retain their leadership.

There is a lack of adjustment between the schools and the industry, said the speaker. A mutual understanding of problems and possibilities is neces sary. About 5 per cent of the total positions open in manufacturing are leadership positions for which men are needed. This amounts to 750,000 men out of about thirteen million men. It is important to stimulate and educate men having a natural talent to become leaders. There is an annual demand for men for these positions. But there is no concerted effort for getting the right men into the right places and consequently there is great waste. We now have 129 engineers' schools with 53,000 enrolled and they form an essential part of industry and industry is showing a growing tendency to properly select and use these men. A study

of graduates who have been out of Rensselear, Harvard, Lehigh and Stevens for five, ten, twenty and twenty-five years show a decided shift from engineering work to other work as years elapse. Some of the shift is due to failure but most is due to a logical change in occupation and advance to position of leadership and responsibility. Experience shows, however, that a good technical expert seldom develops into a good executive but he possesses qualities that are essential to a good executive. Any man who has a scientific mind will generally receive the best education from a course in engineering or applied science even though other characteristics may qualify him for executive and administrative positions.

Recommendations of a group of executives made in the report are:

1. Methods of selection should be improved.
2. Better fundamental training is needed and not specific training.
3. Broader training should be given.
4. More practical training for instruction should be required.
5. More practical training should be incorporated with theoretical preferably during the course.

The committee classes as fundamentals: Mathematics, physics, economics as applied to industry, biology and geology, social relations and civic, history of nations, English, including drawing and writing and chemistry.

Selection must be started back in the preparatory schools and it is now important to improve the quality of the output, it was said. Industry is now awake to the necessity for it to cooperate more actively in educational work in the schools and in the factories. They must stimulate and support the schools to a greater extent. The cooperative courses have produced fine results and should be encouraged and co-operation should take many other forms.

At the session on Thursday afternoon W. E. Wickenden spoke on the topic "The Engineer in Business" and read a report from a committee which stated that a broader equipment must be possessed by engineering teaching staffs and that economic and physical analyses should be a larger element in the pedagogical process. The broad viewpoint of engineering must be the engineering and economic adaptation of science for industrial and social well being. The place of the engineer as a leader in business is not assured, although his leadership in industry is assured. The business world is dominated by considerations which offer handicaps to engineers. In the opinion of Mr. Wickenden leaders cannot be produced in standardized lots by schools and possess no standardized qualities. He cautioned the educators about attempting to train leaders *per se* through any college course and doubted if it would ever be possible to write specifications for leadership which would conform to the changing necessities of national affairs.

MEN YOU SHOULD KNOW ABOUT

Carl O. Lindborg, of Los Angeles, is in China.

Guy N. Bjorge, of San Francisco is at Globe, Ariz., on professional work.

F. C. Schrader is examining antimony deposits near Mountain Home, Idaho.

O. C. Martin, until recently works manager for the Nichols Copper Co. at Laurel Hill, N. Y., has resigned to

O. C. Martin

accept the management of the Perth Amboy plant of the American Smelting & Refining Co. at Maurer, N. J.

Edwin E. Chase, consulting engineer of Denver, is in Tonopah on professional work.

Hjalmar Skougor, of New York, has been visiting Porcupine and Kirkland Lake, Ontario.

William Burley has returned to Los Angeles after two months' absence in Central America.

W. H. Wiley, consulting engineer of Los Angeles, is in Tonopah, Nev., on professional work.

John G. Kirchen has returned to Tonopah after a visit to Washington and San Francisco.

Charles S. Haley, mining engineer of San Francisco, is making mine examinations near Mina, Nev.

William Kemp is supervising preliminary development work in the Uriqui district in western Chihuahua.

James F. McCarthy, president and general manager of the Hecla Mining Co., was recently in Milwaukee, Wis.

L. F. Strobel, engineer on the staff of Karl Eilers, has returned to New York from an inspection trip to various mines in Colorado.

David White of the U. S. Geological Survey has been given the degree of Doctor of Science by the University of Rochester.

W. M. Weigel, who has been selected to be the non-metals specialist for the U. S. Bureau of Mines, at Washington will assume his new duties July 15.

B. R. Bates, representative of the Door Company in Mexico City, is in New York.

Thomas Riggs, vice-president of the Continental Mines, recently made a visit of inspection to the company's Cobalt and Kirkland Lake properties.

Axel Strand, superintendent for the Empire Zinc Co. at Hanover, N. Mex., has returned from Alaska where he went to examine properties for his company.

Cyril W. Knight, associate geologist of Ontario will shortly resign his position with the Department of Mines to enter the service of the Nipissing Mining Co.

R. G. McConnell, former Deputy Minister of Mines at Ottawa, has returned to Sault Ste. Marie, Ont. where he will complete an investigation of the adjacent area.

Frederick B. Hyder, mining engineer specializing in the federal taxation of natural resources, has moved his office to Room 1317, California Commercial Union Building, San Francisco.

J. P. Bickell, accompanied by Sir Wm. Mullock, W. D. Ross, president of the Bank of Nova Scotia, and the directors of the McIntyre mine, have been visiting the company's property in Porcupine.

R. A. Hardy, general manager of the United Comstock Mines Co., has returned to Virginia City after attending the meeting of the western division of the American Mining Congress in San Francisco.

Joseph T. Terry, formerly research chemist for the Utah Copper Co. has opened an office in Salt Lake City as consulting engineer. He will specialize on problems of concentrating complex ores by selective flotation.

George H. Garrey is making a geological examination of the properties of the Cinco Minas Co. of the Marcus Daly Estate in the state of Jalisco, Mex. **H. E. Crawford** is general manager and **Geo. F. Zoffman** is assistant general manager of the Cinco Minas Co.

Dr. G. A. Young, of the Canadian Geological Survey, arrived in Victoria recently and was in conference with William Sloane, Minister of Mines of British Columbia, planning the continuance of his work of surveying the iron ore deposits of the province.

C. G. Maier, who has been directing the research work of the fellows in metallurgy at the University of Utah, an activity carried on in co-operation with the Bureau of Mines, has resigned to accept a position as physical chemist at the Berkeley Experiment Station of the Bureau.

G. P. Robinson, formerly superintendent of the Asarco smelter at Asarco, Durango, has been transferred to the Aguascalientes smelter. Both plants belong to the American Smelting & Refining Co. **K. P. Campbell** assistant superintendent, has been promoted to be general superintendent at Asarco.

THE MINING NEWS

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Leading Events

AGITATORS from Butte, Mont., are said to be organizing miners in the Lake Superior iron mining regions. One strike vote taken already went against a walkout at this time.

The Quinze Power Co. has awarded contracts for equipment for the $3,000,000 hydro-electric project that will supply Porcupine mines with power.

The A. S. & R. Co. probably will take over the smelter of the Cia. Metalurgica Mexicana at San Luis Potosi.

Rich gold ore is found on the 1,800 level of the Cresson mine at Cripple Creek, Colo.

The Ankerite, a promising property in northern Ontario, is to be systematically prospected.

A new suit has been started against the Davis-Daly Copper Co. at Butte. The Hickey interests want $480,000 for alleged wrongful extraction of ore and sundry incidental damages.

Richer copper ore than found heretofore is being mined on the lowest levels of the Quincy mine in Michigan.

C. F. Kelley explains the position of the Anaconda Copper Mining Co. with respect to Pittman Act silver purchases.

Many Nevada companies are turning to California gold mining as a suitable direction in which to expand their operations.

Quincy, in Michigan, Hoists Richer Ore From Bottom Levels

Mass Copper Provides 25 Per Cent of Output—Danger from "Air Blasts" Believed Past

The Quincy Mining Co., in the Michigan copper country, is hoisting copper rock that averages better than any taken out in several years, particularly from No. 2 shaft. A distinctive feature is the improvement in copper content as the workings reach greater depth. Mass copper continues plentiful and constitutes about 25 per cent of Quincy's output. Although the deepest operating level is the 83d, in No. 2 shaft, this shaft is now bottomed at 8,450 ft.; No. 6 is down 8,234. Although No. 2 is one of the deepest shafts in the district, it can be pushed to a much greater depth, as No. 2 hoist, the largest in the world, has a present capacity of 10,000 ft.

The regrinding section in No. 1 stamp mill is recovering values that otherwise would be turned out as waste. A total of 1,786,000 lb. of refined copper was recovered from this source last year, or approximately 15 per cent of production from stamp rock.

No more serious "air blasts" of damaging effect are expected to occur in the mine. Although a series of such blasts badly crushed No. 6 shaft between the 46th and 66th levels a year ago, a careful examination of the ground and openings about the shaft along this section appears to show that the openings are now so crushed and packed together as to carry the weight, so that there probably will be no repetition of "air blasts" in this part of the mine, which was opened many years ago. At that time it was not deemed necessary to leave large protecting pillars on each side of the shaft, as has been the practice during the last fifteen years in the lower parts of the shafts. The bottom or lower 2,000 ft. of all of the shafts is thus protected, and accordingly have never given serious trouble.

Mill Burns in Joplin-Miami District—Will Be Rebuilt

The Indiana Mining Co.'s mill, located southwest of Hockerville, Okla., was completely destroyed by fire on the afternoon of June 19. Defective wiring in the sludge department was given out as the cause of the fire. Two gas engines were saved, after the Picher fire department had reached the scene, but they got a late start on account of inadequate telephone communication. The loss is estimated at $75,000; insurance totaled $25,000. The plant was owned by a company headed by R. B. Jensen of Baxter Springs. There was approximately 1,000 tons of ore in bin at the time of fire. Though the mill had been idle for about two months, it will be rebuilt at once, according to the owners.

Four Rand Mines Pay Dividends

The following dividends have been declared by companies operating on the Rand in South Africa: Langlaagte Estate & Gold Mining Co. 30 per cent, Van Ryne Deep 25 per cent, Witswatersrand Gold 15 per cent, and Government Gold Mining Areas Consolidated 30 per cent.

Quinze Power Co. Starts on $3,000,000 Development Project

Will Supply Mines at Porcupine, Ont.—Contracts Let for Equipment—Aluminum Wire Specified

The Quinze Power Co. is losing no time in pushing the development of the power which it recently acquired. This company, a subsidiary of the Northern Canada Power Co., will supply power to the Porcupine district. The cost of the power-house, equipment and transmission line for the first unit of 20,000 hp. is estimated at $3,000,000. Morrow & Beatty have obtained the contract for the construction of a plant, and a large number of men will be employed. The Dominion Engineering Co. of Montreal has obtained the contract for the water wheels, with a six-months delivery. The Swedish Electric Co., of Sweden has been given the contract for the generators, electric switching apparatus, step-up and step-down transformers. The Can. Porcelain Co., Ltd., of Hamilton has the contract for the insulators and all transmission line hardware. The Canada Bridge Co. has the contract for 972 steel towers for the transmission line, first delivery to be made in six weeks. The Northern Aluminum Co. has the contract for 720 miles of aluminum transmission wire. It is expected that eventually 1,000 men will be employed on the job, and the company hopes to be able to deliver power to Porcupine by the summer or fall of 1924. Operations in northern Ontario have suffered seriously from inadequate power in the past.

New Suit Started Against Davis-Daly Company at Butte

Hickey Interests Want $470,000 for Alleged Wrongful Extraction of Ore and Other Damage

A suit for $470,000 for ores extracted and damage resulting from injury to plaintiffs property was filed in the federal court at Butte on June 16, against the Davis-Daly Copper Co. by attorneys for Thomas F. Hickey and the heirs of Edward and Michael Hickey. The ore involved was mined from the Lizzie lode. The company is already engaged in litigation with the Anaconda Copper Company wherein some of its most important orebodies are involved.

The complaint in the new suit recites that on July 10, 1899, Edward Hickey, Thomas F. Hickey and Michael A. Hickey were, by United States patent, owners of the whole of the Lizzie lode. On this date Edward, Thomas and Michael Hickey, by deed conveyed to Martin Burris all that portion of the Lizzie lode—outside the "shaft tract"—lying below 100 ft. from the surface. Burris' deed stated that he might extract all ore lying below the level named but excluded him from mining above the 100-ft. limit from the surface outside the shaft tract. The shaft tract, on which no limitation was placed, is described as "90 ft. in front by 125 ft. in depth, situated on the south side of East Park Street and bounded as follows:

'Beginning at the northeast corner of the lot now occupied by house No. 432 East Park Street and running in a southerly direction along the east line of said lot 125 ft.; thence easterly along a line parallel to the south line of Park Street and 125 ft. distant therefrom, 90 ft.; thence northerly and along a line parallel to and 90 ft. easterly from the east side line of said lot 125 ft. to a point on the south line of East Park Street; thence westerly along said south line of East Park Street 90 ft. to the place of beginning.'"

On this tract the Lizzie shaft had been sunk to a depth of 300 ft.

Burris, the complaint states, transferred his title to the Davis-Daly Copper Co. on Sept. 22, 1908. The Hickeys continued to be the owner of the orebodies above the 100 ft. level in the Lizzie tract.

In the years 1918 and 1919, it is alleged the defendant company through its agents and particularly by the Butte-Ramsdell Company as its lessees, entered upon the reserved ground and extracted ores which the plaintiffs estimated to be worth $430,000. They, it is charged, also caved and flooded the workings.

In the second cause for action, plaintiffs allege that the defendants leased the property to John P. McNulty and others and that ores were extracted, workings flooded and damages resulted; that plaintiffs had no knowledge of this invasion of this property until about two months ago; that it will be impossible to determine the extent of the workings or the amount of ores extracted except by an inspection of the defendant's books, plats, maps, profiles and other records of defendants and its lessees. For these "intentional and wilful acts" plaintiffs ask an additional $40,000, making $470,000 in all.

The officials of the Davis-Daly Copper Co. state the ores in question were owned by their company.

Butte "Radicals" Seek to Organize Lake Superior Iron Miners

Strike Vote Fails—Conservative Men Predominate—No Strike Since 1895

Labor agitators said to belong to the I. W. W. in Butte, Mont., are active in the Iron River, Mich., district of the Lake Superior region and an attempt has already been made there to call a strike. At a meeting of miners, attended by about 200, a strike vote was taken, but the men did not favor a strike at this time, desiring to wait until better organization is effected in the several Michigan iron-ore ranges. It is not thought that the agitators will be successful in their efforts, as the more conservative miners are familiar with the tactics of the I. W. W. and will be slow to join them. The strike in the Michigan copper district, in 1914, is still fresh in the minds of many of the underground men. There has not been a strike of any proportion on the Michigan iron ranges since 1895.

Several Companies Ship Zinc to Trail Smelter

Ore and concentrate shipments received by the Consolidated M. & S. Co. of Canada, at its Trail smelter during the period June 8 to 14 inclusive, were as follows:

Name of Mine	Locality	Tons
Alamo mill (Lead)	Alamo, B. C.	54
Alamo mill (Zinc)	Alamo, B. C.	40
Bell	Beaverdell, B. C.	43
Bosun (Lead)	New Denver, B. C.	43
Bosun (Zinc)	New Denver, B. C.	59
Knob Hill	Republic, Wash.	54
Quilp	Republic, Wash.	103
Lone Pine Surprise	Republic, Wash.	330
Providence	Greenwood, B. C.	4
Park Group	Marysville, B. C.	30
Silversmith (Lead)	Sandon, B. C.	87
Salmo Ore	Salmo, B. C.	41
Standard (Zinc)	Silverton, B. C.	112
Standard (Lead)	Silverton, B. C.	44
Company mines	.....	9,826
	Total.....	10,870

Governor Hart of Washington Proposes Commission to Write "Blue Sky" Law

Louis F. Hart, Governor of the state of Washington has suggested to the Western Division of the American Mining Congress that a commission be appointed consisting of members appointed from each of the western mining states by the Governors with a view of framing a practicable "blue sky law" designed to protect the public from fraudulent mining promotions and at the same time encourage legitimate mining.

Arizona's Asbestos Industry Shows Signs of Life

Contract, Signed Recently, Provides for Regular Deliveries in the East—Low Iron Content Attracts

A. J. Dunaway, of Miami, Ariz., has secured a contract with a Pennsylvania consumer that will enable him to mine and ship asbestos from his claims which are located in Gila County. This will be the first shipped regularly from Arizona's asbestos district for some time as most of the properties have been idle for many months. Companies have maintained watchmen and caretakers at the mines since suspension of operations and in some places prospecting has been carried on but only small amounts of the fiber has been marketed. The assessment work on many hundreds of locations has been promptly attended to, plants have been kept in readiness and operators look forward to the establishment of a market that will enable a general resumption of mining. The product of this district is of unusually fine quality; it contains little iron and is a long, clear fiber of great tensile strength. However, due to the high cost of mining, largely because of the fact that the mines are in isolated localities, local producers have been unable to compete with foreign supplies. The textile manufacturer, with whom Mr. Dunaway has arranged a contract, requires a product free from iron and it is for that reason that the Arizona product is to be secured. Seventeen tons were shipped recently and mining and shipping is to be continued regularly.

Two Rich Strikes in Clear Creek County, Colorado

Very rich gold ore is said to have been opened by the Frank J. Hayes Mining Co. in its mine in Virginia Canon in Clear Creek County, Colorado. A shipment of sacked ore averages $5 per pound. A shoot of high grade smelting ore has been opened by the Mattie Consolidated. This company is also milling 75 tons of lower grade ore daily. Concentrate and high-grade ore are shipped to the smelter at Leadville.

Shake-Up in Kay Copper Co. Affairs—Development Planned

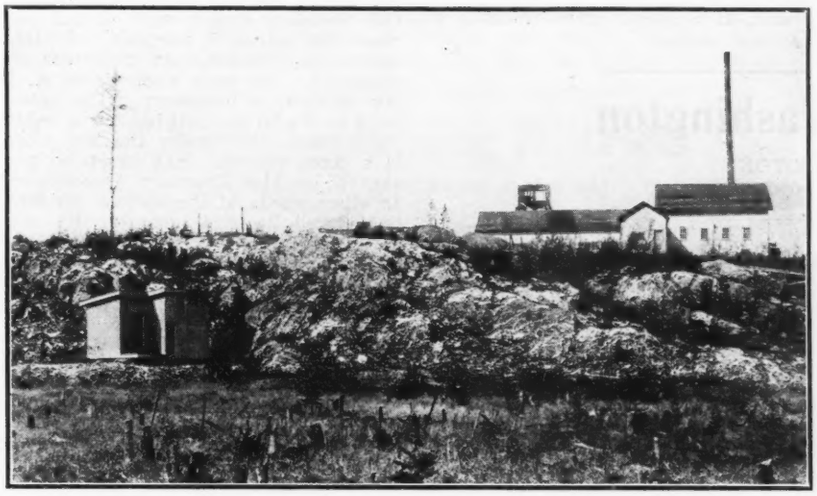
The Long-McIver interests recently sold their holdings in the Kay Copper Co., operating a property in Arizona, for what was reported to be a consideration of real cash money. The mine is to be taken over by a New York corporation which, it is said, is planning to proceed with development on a large scale. The Kay mine is located about 40 miles north of Phoenix on the Agua Fria River. The company announced plans for the development of the property a short time ago and a crew of men were put to work, but it was soon seen that a reorganization and refinancing would be necessary.

Ankerite Development Financed by Private Subscription

Porcupine, Ont., Property Has Promising Showing—Similar Operations in Same Gold District

By J. C. Murray

The most notable new development in the Porcupine gold-mining district, in northern Ontario, is the starting of active work at the Ankerite mine. Clifford E. C. Smith, president of the North America Gold Corporation, and Norman C. Stines, consulting engineer, are planning and superintending the work. The power plant has been put in operation and its capacity increased. All the underground workings will soon be unwatered. Further development of the large known orebodies will then be initiated, and the property will be more completely equipped.



Ankerite property, showing powerhouse and typical outcrop

The Ankerite, which was staked in 1910, is one of the interesting properties of Deloro Township. It lies in the great shear-zone on which the Dome mine is situated, and which traverses the southeast corner of Tisdale Township and the northwest part of Deloro. The geological relationships of the intrusive quartz-porphyries and the schisted and altered country rock are strikingly apparent on the bold outcrops of the Ankerite. The vein systems are, in part, traceable on the surface.

After preliminary examination, Mr Smith took over the property in the autumn of 1915. In the spring of 1916 he began exploration and development. Work was carried on actively until 1918. For unannounced reasons the mine was then closed down, although some orebodies had been found and partly developed. The general belief is that radical differences of opinion between the parties interested were the immediate cause of the stoppage of work, in spite of the reasonably good showing that had been made.

The North America Gold Corporation acquired title to the property in August, 1922. Delay was caused, however, by the action of underwriters in issuing unauthorized advertisements of shares in direct violation of contracts with the corporation. Cancellation of the contracts with these underwriters having been officially completed, the corporation entered into a new agreement with private interests who undertook to finance the operation of the Ankerite. No stock is to be offered to the public, and the enterprise is to be conducted as a private undertaking.

It is significant and gratifying to observe substantial private investments of this kind. There is much more of this unadvertised activity in northern Ontario than is generally known. The Porcupine Paymaster is developing extensions of the Ankerite vein system No. 2. On the Paymaster spectacular ore has been opened up during the last few months. It is controlled by private Boston capital. The same company controls and is developing the property of the United Mineral Lands Co., wherein lie easterly extensions of Ankerite vein system No. 1.

Duke of Manchester Arrives in Quebec on Prospecting Mission

The Duke of Manchester arrived at Quebec from England on June 19; he will spend two months in northern Quebec where he has interests in 6,000 acres of gold claims in Dubuisson Township west of Lake de Montigny. He states that "there will be at least three mines opened on our claims and later perhaps fifteen." If the operations are successful he will interest British capital and sell shares in England. He says that already one mine has been worked to the 400 level, and that a large financial firm in London is ready to expend $1,000,000 to develop the mine "if it is thought advisable." That seems to be a safe way to put it. It is understood that in addition to his Quebec holdings the Duke is interested in Ontario mining claims. Presumably the Duke will combine business with pleasure on the expedition, as northern Quebec offers much as a vacation ground.

A. S. & R. Will Buy Control of Smelter at San Luis Potosi

Deal Awaits Approval of Federal Court—Cia. Metalurgica Mexicana in Hands of Receiver

A dispatch from San Luis Potosi, in Mexico says: "It is rumored that the American Smelting & Refining Co. has, or shortly will acquire control of the smelter here." This plant was constructed by the Cia. Metalurgica Mexicana, organized in 1890 with a capitalization of $4,000,000. It soon acquired extensive interests in various parts of Mexico, among the more important being the property of the Sombrerete Mining Co. and Mexican Lead Co., at Sombrerete, in the state of Zacatecas; the Veta Rica mine, at Sierra Mojada; the Cerro Prieto properties, at Concepcion del Oro; the San Pedro and San Pablo mines, and the Flojonales mines, in the state of Durango.

The smelter was first installed with a daily capacity of 750 tons, having twelve furnaces for the reduction of gold, silver and lead ores and a special copper department of 100 tons' daily capacity. Robert S. Towne was the first president of the company, with Donald C. Brown, general manager and Geo. H. Carnahan, general mine superintendent.

New York officials of the A. S. & R. Co. say that the arrangement whereby their company will take over the smelter awaits the action of the U. S. Federal Court in approving the deal. The Cia. Metalurgica Mexicana is in the hands of a receiver and his action must be approved by the court before the plan becomes effective. It is believed that full details will be announced early in July.

Must Put Safety Recommendations in Black and White

District engineers of the U. S. Bureau of Mines and the engineers on its mine rescue cars have been instructed to make written reports, whenever possible, to mine operators, containing recommendations for more effective prevention of accidents and for improvement of health conditions in the mines examined. Obviously it will be a good thing to have such recommendations made matters of record so that in case of controversy it can be proved just what advice was given.

Rich Find in Cresson Mine at Cripple Creek

It is officially reported that remarkably rich ore has been found in virgin territory on the 1,600 level of the Cresson mine at Cripple Creek, Colo. Only a few cars have been shipped from the new stope but these have been of exceptionally high grade. The full extent of the shoot has yet to be determined. On the 1,000 level in stope 1111 there are said to be 60,000 tons of broken ore that will average more than $10 per ton.

Mysterious Explosion in Aurora Iron Mine in Michigan

In the Aurora mine of the Oliver Iron Mining Co. in the Gogebic range in Michigan a severe explosion occured in the north end of the cross-cut on the fifteenth level, some 700 ft. from "E" shaft. This end of the cross-cut was in waste and was not in active use, but a dozen gangs of miners had their powder boxes there. Powder is delivered to the mine twice a week so there is never much in the mine at one time. On the night of June 21 these men had some 500 lb. of dynamite in their boxes, and between the hours of five and eight in the evening, when the crews were off shift, this powder was exploded by some unknown cause. Fortunately no one was in the mine between shifts and so there were no casualties. The extent of the damage is not yet known, several tram cars were wrecked, and the timbering was stripped from 200 or 300 ft. of the crosscut.

It may be that damage occurred in the drift to "F" shaft also. The place where the miners kept their powder boxes was shut off from all traveling roads and was electrically lighted and no one was allowed to take a lighted lamp there, so it is difficult to account for the explosion, especially as the electric power was shut off at the time the blast occurred. The exact time is not known as the explosion was not noticed on surface, only gas issuing from the shaft when the miners went on shift at 8 o'clock gave warning of what had occured.

News from Washington

By PAUL WOOTON
Special Correspondent

Anaconda Will Settle on "95-Per Cent" Base if Other Companies Will

C. F. Kelley Explains Stand on Pittman Act Silver Sales—Willing to Estimate Metallurgical Loss

To make sure that there is no misunderstanding as to what the Anaconda Copper company is willing to do in connection with the accounting and crediting of sales of Pittman silver, C. F. Kelley, the president of the company, has written S. Parker Gilbert, Jr., the undersecretary of the Treasury, setting forth his position in full. An extract from his letter follows:

"Senator Pittman emphasizes his belief that instead of undertaking to ascertain precisely what were the metallurgical losses in each case, by following the silver back through the various processes, it would, in his opinion, be better to adopt an arbitrary settlement of 95 per cent, allowing 5 per cent for metallurgical losses.

"I do not agree with the inference contained in Senator Pittman's letter that a 5 per cent loss was estimated when the silver was purchased from miners and in that connection I showed Senator Pittman a number of circular letters issued by the Anaconda company, in which miners were advised that a settlement should be on the basis of 100 per cent of the silver, after the Treasury regulation became effective, and an addition was made to the treatment charge to cover the difference between this amount and the charge made when less than 100 per cent was accounted for under old contracts.

"In response to Senator Pittman's suggestion that he would try to get every one to agree to a settlement on a 95 per cent basis, thus reopening purchases by the mint to the extent of the difference between the proposed arbitrary settlement of 95 per cent and the actual deliveries which have been made by various companies to the mint, I did say that the Anaconda company would agree to a 95 per cent settlement provided every other seller of silver to the mint likewise agreed to a 95 per cent settlement and provided further that the mint come into the market to purchase the difference between 95 per cent and the amount purchaseable under the Act. It was not my intention and it is not now, nor will the Aanaconda company agree of itself to tender 100 per cent in affidavits for a settlement of 95 per cent in deliveries, the point I had in mind being that if a settlement on a 95 per cent basis would result in a purchase by the mint of an additional 5 per cent of silver, the proportion which would come to the Aanaconda company would offset any loss which might be sustained by making the arbitrary deduction of 5 per cent for metallurgical losses."

A copy of the foregoing letter was sent to Senator Pittman, who has replied to Mr. Kelley, as follows:

"The last paragraph of my letter [written to Mr. Gilbert] which is as follows: 'He [Mr. Kelley] stated that his company would be willing to deliver affidavits showing purchases of 100 oz. of silver for every 95 oz. tendered or sold to the Government under the Pittman Act.' is the exact statement that was made to me by you as I left your office.

"The statement in the preceding paragraph was only intended to be descriptive of the transaction and was not intended to commit you to the statement that you had only paid the miners for 95 per cent of the silver. Of course, I contend that the evidence discloses this to be a fact no matter what the miners swore to or how the settlement sheets read. If there is any inconsistency between the second and third paragraphs of my letter, your letter to Mr. Gilbert has fully explained your position.

"I do not remember any agreement upon my part to undertake to get all of the other silver producers to settle on the same basis. I realize that such an undertaking would require a long time to consummate, and even then it would be quite uncertain. On the contrary, I have at all times had in mind, as my letter to Mr. Gilbert, which is printed in the hearings discloses, that it was and is the duty of the Treasury Department to insist upon settlement upon a 95 per cent basis. In stating that your company was willing to settle on such basis—that is, to deliver 100 per cent of affidavits for 95 per cent of silver delivered—I, of course, understood that you were only willing to do this provided all the others did it. The only way to accomplish this is for the Treasury Department to insist upon it.

"As far as any understanding that the Treasury Department should purchase the other 5 per cent of silver under the Pittman Act, this was not discussed. No such understanding, in my opinion, is necessary. The settlement on the 95 per cent basis will reduce the tenders, and, under the law, there is a fixed amount that must be purchased by the Treasury Department. In other words, if the amount tendered is reduced 3 or 4 per cent by such settlement, then such 3 or 4 per cent additional silver must be purchased under the Pittman Act to make up the amount of silver required to be purchased.

"I do not believe that anyone will misunderstand my letter to Mr. Gilbert, but if there is, in your opinion, any doubt or misunderstanding, you are at perfect liberty to publish your correspondence with regard to the subject and I will, if you desire, have all the correspondence relative to this subject published in the next hearings. I felt that you had acted in a splendid spirit of fairness and have set a good example for other companies similarily situated."

Commissioner Briar Disallows Many War Minerals Claims

No Basis for Many Claims for Reimbursement—Six Awards Approved by Secretary of Interior

Recommendations for awards and disallowances made by John Briar, the War Minerals Relief Commissioner, have been approved by the Secretary of the Interior as follows: Rice, Kipp & Burrough, chrome, $1,295; E. K. Henderson, tungsten, $351; Yates & Yates, tungsten, $1,913.01; C. H. Craig, tungsten, $827.10; Moran Bros., manganese, $7,883.77; J. E. Marks, chrome, $142.91; Black Bess Chrome Association, chrome, no further award; Sowden and Co., tungsten, net loss not established; C. J. Crawford, manganese, not within the Act; W. S. Jones, manganese, basis for claim not established; Gloria Mining Co., manganese, no further award; Charles Hjertquist, tungsten, request not established; Joseph L. Sowell, chrome, no further award; Oklahoma-Kansas Mining Co., manganese, losses not reimbursible under the Act; Shepherd & Baker, manganese, no further award; W. B. Oliphant, chrome, no further award; Adams & Shell, manganese, losses not reimbursible; Edmonds & McCurry, manganese, no

further award; Headding, Newman & Headding, tungsten, losses not reimbursible; E. W. Waybright, manganese, right to award not established; Howell & Ross, chrome, no further award; Charles H. Mulkey, chrome, commercial importance not established; Albert Brinkerhoff, manganese, not within the Act; Charles M. Tucker, chrome, no further award; Frank Cain, chrome, commercial importance not established; Floyd Pearce, manganese, commercial importance not established; Anderson, Hilbert & Robinson, chrome, no additional award; Earl H. Young, manganese and chrome, manganese losses antedated stimulation, commercial importance chrome property not established; J. N. M. Shimer, tungsten, not within the Act; H. M. Shimer & Co., chrome, not within the Act; H. M. Shimer & Co., tungsten, not within the Act; Bean & Singer, tungsten, not within the Act; Wm. A. Blanton, chrome, no additional award; Lang, Aydlott & Williams, chrome, no additional award.

S. P. Gilbert, Storm Center of Pittman Act Controversy, Resigns

S. Parker Gilbert, Jr., the undersecretary of the Treasury, who has become widely known to the mining industry through his connection with the administration of the Pittman Act, has resigned to take up again his practice of law which was interrupted five years ago when he entered the government service. Since Mr. Gilbert will continue to serve until Secretary Mellon's return from Europe, he will be constantly available to the Senate Commission of Gold and Silver Inquiry during its probe into the Pittman purchases.

News by Mining Districts

By Special Correspondents in the Field

London Letter

Perkins Process for Pilbara—International Mining Exhibition Success—Good Showing for Shamva

BY W. A. DOMAN

London, June 14 — Since Edward Hooper joined the board of the Namaqua Copper Co. (South Africa) he has not been idle. He has paid a visit to the mines. Whereas formerly colonial coke was found unsuitable for the smelter, owing to the intractable nature of the Namaqua ores, this fuel can now be used altogether. There is no economy in its use, but supplies are more regular than Welsh coke. The blister copper averages nearly 99 per cent pure copper, and is now registered on the London Metal Exchange.

The directors of the Pilbara Copper Fields (North Western Australia) have decided to adopt the Perkins process, controlled by Minerals Separation, and have entered into an agreement accordingly. For testing purposes twenty tons of 6 per cent ore was recently shipped to England, and 90 per cent of the copper content was recovered. Minerals Separation estimates that the cost of producing "Best Selected" copper on the basis of treating 200 tons of 6 per cent ore daily will be £40 3s. 4d, or, delivered in London, £43 19s. 7d. Hugh F. Marriott inspected the process and expressed himself satisfied as to its application to Pilbara ore. Minerals Separation has not only agreed to accept the position of metallurgical advisers to Pilbara Copper Fields for a term of three years, but has agreed to supervise the erection and working of the plant in Australia. The plant is to have a capacity of 200 tons daily.

The International Mining Exhibition at the Royal Agricultural Hall, Islington, may be considered a great success. Being of a technical character, it has not attracted the multitude, but the right class of person has attended, and so far as can be gathered exhibitors are well pleased. The government geologist of the Gold Coast (West Africa) was present, and expressed himself in hopeful terms of the mineral future of that territory. A fair quantity of small diamonds is being won on the concession of the Akim company, and similar stones have been found over a much wider area. The representatives of the Mexican, Colombian, and French governments have held receptions.

From the standpoint of expenses, the Shamva Mines (Rhodesia) makes an excellent showing for the last calendar year. Originally, it was estimated that a ton of ore would be treated for about 8s., but the figure has averaged considerably in excess of this. In 1921 it was 122.5d., and last year was reduced to 107.85d. In 1915 it was 99.8d. Another interesting point in the report is that development work at depth during last year gave favorable results. This work cost £3 13s. 2d. a foot. The feed to the mill averaged 3.346 dwt. and the actual extraction was 87.3 per cent, which is good considering the low gold content. It has been decided to install the Crowe vacuum process throughout to treat the whole cyanide solution, and as a result economies are anticipated in zinc and cyanide. The total ore reserves are 2,248,922 tons of an average value of 3.5 dwt.

BURMA

Burma Corporation's May Output 3,644 Tons Lead and 380,332 Oz. Silver

During the month of May the Burma Corporation mined 18,626 tons of ore at its Bawdwin mines; and 21,720 tons was milled. This produced 11,096 tons of leady concentrate. A total of 11,574 tons of lead-bearing material was smelted in the blast furnaces, producing 4,070 tons hard lead for treatment in the refinery. Refinery products were 3,644 tons of refined lead and 380,332 oz. of refined silver. The tonnage milled includes retreatment of 2,019 tons of old tailing.

San Francisco Letter

Nevada Companies Develop Increased Interest in California Gold Mines —Four Gold Dredges Busy

By Our Special Correspondent.

San Francisco, June 20—Nevada mining companies are increasing their interests in California. Recently the Marne Divide Mining Co. purchased the North Extension and Red Cloud mining claims adjoining the Confidence mine, near Tuolumne. The Belcher Extension Co. is prospecting with fair success, it is said, claims in the Randsburg district, and the Tonopah Divide Co. has started work on the Victor and Gold Coin claims, adjoining the Yellow Dog claims of L. L. Patrick, of Goldfield, Nev., in the Mojave district near Randsburg. The Tonopah Mining Co. has tried out a property near Tuolumne with indifferent success. The Belmont is working the Belmont Shawmut with prospects of a good year. There is noticeable a strong tendency on the part of the Nevada operators to get into the gold-mining game. Diversified mining will even up the depressions and is on the whole a sensible procedure.

Four gold dredges are operating in the Trinity River, the Estabrook at Trinity Center, the Trinity dredge, the Gardella below Lewiston, and the Lewiston dredge below Trinity Center. A few small lode mines and miscellaneous placer operations are active in the vicinity of Carrville. Work has been resumed by the American Zinc & Lead Co. at its property contiguous to the Uncle Sam mine, after temporary repairs were made to its compressor plant that was damaged by an electrical storm.

In the Grass Valley district the Alta Hill shaft has reached a depth of 160 ft.; the Alcalde is extending a south drift on its 300 level; the Brunswick Mining Co. has completed a sump and begun exploration work. In the vicinity of El Dorado, several properties have been reopened; the Good Luck mine, near Diamond Springs, has been unwatered and development work started; an interest has been acquired in the Martinez group adjacent to the Union mine by C. L. Pinney and E. H. Altoft, of Los Angeles.

Net profit of the Carson Hill Gold Mining Co. for the first quarter of 1923 is stated to be $81,767, before deducting depletion and taxes. W. J. Woolsey has formed a company to take over several small properties near Sonora. The Grizzly mine, near Tuolumne, is to be shut down, as the results of recent exploration work have been disappointing. At Copperopolis the Calaveras Copper Co. is putting additional men to work as fast as they can be obtained.

QUEENSLAND

Ajax Copper Mine Being Developed—Arsenic Producers Plan Export to the United States

Special Correspondence

The Mount Morgan Co. has lately leased, doubtless with the option of purchase, the Ajax copper mine, which it intends to prospect and, if found good enough, to develop for the purpose of providing extra supplies of cupriferous ores for its smelting works. This mine is eight miles from the station of Bajool, which is on the main North Coast Railway, and which is 44 miles distant by rail from Mount Morgan. The discovery of the mine was reported by the local warden about three years ago as being one of the most promising deposits found in the central district, but the slump in copper that took place about this time forced the leaseholders to seek exemption.

One sample of ore consisting of rich copper glance and carbonate ores, went as high as 29 per cent of copper, with 5 oz. of silver per ton, and another gave a return of 22 per cent, but all the other samples assayed gave returns ranging from 15 per cent down to 1 per cent of copper. The government geologist who took these samples expressed doubt as to whether it would pay, at the time of his report, when electrolytic copper was £71 per ton, to ship to southern smelters ore assaying less than 20 per cent. Nevertheless he considered the gossans were so impressive in their bulk and physical characteristics that their thorough testing should be undertaken immediately.

The rise that took place in the price of arsenic two or three months ago, on account of the large demand for the product to combat the boll weevil in the cotton fields of the United States, has had the effect of calling attention to the arsenic-producing possibilities of Queensland. There are already three mines, including that owned by the government, in the Stanthorpe district, where this poison is won as a primary product. The output of these three mines, which amounted to 400 tons last year, has so far been used only for the local supply of arsenic for destroying prickly pear and other noxious plants, but 200 tons of last year's production of the state mine remained on hand at the end of the year. So far none has been exported, but it is certain that if the lately prevailing demand for arsenic abroad continues not only will the Stanthorpe mines increase their output, which can easily be done, but that others of the many deposits of arsenic known to occur in Queensland will be exploited, and the product shipped to America. Native arsenic has been found, among other localities, in the Chillagoe and Herberton districts, on the Charters Towers gold field, at Kilkivan and Gympie; also as mispickel (arsenical pyrites), in association with other minerals, in a great number of other places throughout Queensland.

News from the Normanby gold field, of which sanguine expectations had been entertained since the efforts put forth a year or two ago to revive it, indicates that results are not proving altogether as good as had been expected. The Billy Hughes Co., the chief concern operating on the field, having pinned its faith to the Frederick mine as the best of its group, put up a mill at this property. The returns from actual crushings, however, have been disappointing, and it is turning out that better ore is to be got from other mines, which are unfortunately not readily accessible to the company's mill (the only one on the field), especially in wet weather. The battery consequently has been hung up for some time, awaiting suitable conditions, but has lately resumed. Outside the Frederick mine, 18 tons of ore from which has only yielded an average of 14 dwt. to the ton, some small crushings from other holdings have given good returns, ranging from 2 oz. to 25 dwt. per ton. A parcel of concentrates, which is being sent to Bowen, 50 miles distant, for shipment to Port Kembla in New South Wales, is expected to return 6 oz. per ton. Owing to the inaccessibility of the field, fairly good yields will need to be obtained to make operations remunerative.

At the cobalt mine at Mount Cobalt, Cluncurry, the shear crushers for grinding the ore were found to be unsuitable, and a ball mill of the Marcy type is being substituted. So far ball mills have not been popular in Queensland, but another one (also a Marcy) is being installed to treat the silver-lead ore from one of the mines at the Brisbane suburb of Indooroopilly.

At Mount Cobalt the main shaft is down 170 ft., and is still being deepened, while stoping is being carried out at the 50-ft. level. Scarcity of water has been a great drawback at this mine. Just now it is sufficient for present purposes, but, in order if possible to avoid trouble in this direction in future, a well is being sunk to a depth of 140 ft. on a site where a supply had been previously found by boring.

MEXICO

New Company Will Operate Toro Mine

A new company has been organized in Mexico for the purpose of operating the Toro mine in the Zaculpan district. It is recorded as the Cia. Minera El Toro, capitalized at $200,000—4,000 shares of $50 each. The Toro mine is located near the Alacran property and was one of the first bonanzas of the Zaculpan camp. It has formerly been operated for some years by E. Trager and Leo Gadd.

Enlargement of La Fe Mill Finished

La Fe Mining Co., operating at Guadalupe, near the city of Zacatecas, has completed the enlargement of its mill and made numerous repairs about the plant and mines. Good bodies of ore are blocked out and operations will be greatly increased as soon as the new plant is taking ore regularly.

BRITISH COLUMBIA

Peace River Property To Be Developed —Free-Milling Gold Ore

G. W. McAllister has left Prince George with a party of miners for the Peace River Mining & Milling Co.'s property, at the junction of the Parsnip and Findlay rivers. Mr. McAllister has spent several seasons in this district, developing an immense body of free-milling gold ore, which is said to be half a mile wide and to have been traced for two and a half miles. Tests in a small mill, last year, gave a return of $6.50 per ton. The property has been examined by a number of engineers, but its inaccessibility—350 miles by river from Prince George—is said to have been the bar that has prevented capitalists entertaining it.

British Want Clean Zinc Ore

Inquiries for zinc ore to be shipped to England are being addressed to the Boards of Trade of British Columbia. Large shipments of sphalerite ore or concentrate containing no lead or silver are desired sacked for transatlantic shipment. The zinc market is a controlling factor in the prosperity of some of the camps of British Columbia which ceased active operation some years ago on account of the large percentage of zinc associated with the lead-silver ores as depth was attained. Many mines chiefly valuable for their zinc ores are resuming operation or contracting with leasers on account of the recent demands made for zinc ore.

ONTARIO

Fire Menace Disappears

The fire situation in northern Ontario and northwestern Quebec has caused a good deal of concern during the last week or two, but the danger now appears to be over. There were two dangerous fires in the immediate vicinity of Porcupine, but a change of wind and a certain amount of rain has apparently removed the menace. A section of the transmission line of the power company was burned, which closed the mines for approximately twenty-four hours, but conditions are now back to normal.

McIntyre Outlook Bright According to Forecast of Report

The fiscal year of the McIntyre closes June 30. The report is expected to show greatly improved earnings for the present year. It is understood that the output of the mine is now running approximately $300,000 a month, of which about 50 per cent will be profit. The present dividend is at the rate of 15 per cent a year, and although the directors have made no announcement regarding an increase, it is expected that this rate will be increased soon. The more important vein systems of the Hollinger are entering the McIntyre at depth, and the company has what practically amounts to a new mine below the 1,500 level.

ARIZONA

Cochise Will Unwater Mine

The Cochise Leasing Co. is preparing to start bailing out its mine in the Bisbee district, near Lowell, and a crew of men are to be put to work in a few days. It is planned to bail out the water to the 300 level, where development will be conducted. The former operators, the Cochise Development Co., cut some favorable veins, before closing the mine in 1906. The present company plans to prospect for the extension of orebodies that have been found in adjoining properties.

Dripping Springs Development Starts

A. S. Copley, superintendent of the Dripping Springs Copper Co., has announced that his company has appropriated $10,000 per month to be spent in the development of the company's property. A crew of men is to be employed at once. The mine is located between Winkleman and Globe and developments have been conducted intermittently for many years. The equipment at the property consists of compressor, Diesel engine, gas engine, houses for employees and other company buildings. It is expected that some exploration of the ground will be done by diamond drilling.

Copper Queen Concentrator at Half Capacity

One of the blast furnaces at the Copper Queen Smelter at Douglas has been shut down until the new mill at Warren is operating at full capacity. About 2,000 tons per day is being treated at the mill now and the management expects to have the capacity doubled within another month. The Phelps Dodge operations at Morenci will not be expanded until alterations and repairs in No. 6 concentrator have been completed. This work, which is being done under the direction of Arthur Crowfoot, should be completed in about six months. Smelter and mine forces will be increased at that time. There seems to be little apprehension on the part of the company on account of the lower copper market.

Operations Resumed in the Gleason District

There is evidence of resumption of mining activities in the Gleason district, and many small properties are being started. A force of twenty men is at work at the Mystery Mining Co.'s property. Machinery has been installed and the work of driving a crosscut to the ledge is progressing rapidly. The tunnel is now in 135 ft. and it is estimated that the main orebody will be reached at about 600 ft. Small pockets of ore have been intersected within the distance already driven that will be prospected later. The Shannon Copper Co. has put several men to work repairing track to the mine and equipment and supplies have been ordered preparatory to a general resumption of mining. It is expected that other prospects will be started before summer.

Verde Central Near Critical Point

Interest is being evidenced in developments under way at the Verde Central mine, of the Jerome district, where a crosscut is being driven on the 1,000 level. This working is directed to intersect the downward extension of a contact, along which, on the 700 level, ore is found for a distance of about 800 ft. The face is in a soft, well-mineralized schist, containing quartz and some chalcopyrite at a distance of 300 ft. from the shaft. It is estimated that the contact will be encountered within 100 ft. This development will show the character of Verde Central's ore at depth, and the result is being looked forward to by those interested in the district.

NEVADA

Tonopah Divide Suspends Production Temporarily

Output of the Tonopah Divide mine at Divide in May was about the same as April and as large as for any month in the history of the mine. Exact figures on tonnage and values have not been given out but it is known that daily shipments averaged nearly 150 tons, about 100 tons being mine ore and the other 50 tons being second-class dump ore containing low but profitable values. Net receipts, after deducting milling and losses, are reported to have been $80,000, which would indicate a net profit of over $60,000. During the first two weeks of June no ore was shipped as it was necessary to do considerable shaft repair work which has been accumulating for several months. It is not considered likely that future production will be at the rate maintained during the past few months, but substantial shipments will be made and a more liberal development program carried out, development having been curtailed for some time in order to devote all possible energy to ore production during the life of the Pittman Act. The crosscut on the 1300 level is to be driven to the southwest in order to locate the vein at that elevation. All deep level work has been suspended for some time and it is to be hoped that nothing will interfere with these deeper operations as the future of the mine depends on opening of profitable ore at depth.

Cortez Mill in Operation

The 100-ton concentrating and cyaniding plant of the Consolidated Cortez Silver Mines Co., at Cortez, is in operation at part capacity, and tonnage will be increased gradually, thus giving a thorough opportunity to test the machinery and process. The mine contains a large tonnage of low-grade fills which will be mixed with the higher grade ore produced by leasers and from company operations. It is not likely that any shipments of concentrates will be made before the end of June so that actual rate of production cannot be known at the present time.

UTAH

Three Pay Quarterly Dividends

The Park City Mining & Smelting, and the Park Utah, under the same management, will on July 2 pay their regular quarterly dividends. The Park-Utah will pay at the rate of 15c. a share, the total dividend amounting to $150,000; and the Park City Mining & Smelting, at the rate of 12½c. a share, the total amount being $109,500. The total paid by the Park City Mining & Smelting, organized a year ago, will be, with the coming dividend, $306,500; but as the company embraces properties with a long record of production the real total amounts to over $10,500,000. The Park Utah, lying in the eastern section of the Park City district, is a property with a shorter history. This company, which began dividend payments a little more than a year and a half ago and which has developed one of the important silver-lead mines of the country, will have a total dividend record of $850,000 when the coming dividend has been paid. In addition, cash assets of this company as of June 1, were shown by the books to exceed $900,000. On June 1, cash of the Park City Mining & Smelting exceeded $1,000,000.

The Tintic Standard, in the Eureka district, will pay 15c. a share, as compared with 10c. the quarter preceding; 7c. is the dividend proper, and 8c. is added from the depletion reserve. The amount of this dividend will be $166,205.

WASHINGTON

High-Grade Gold-Silver-Copper Ore in Olympic Mountains

The copper district at the head of the South fork of the Quinalt River in the main range of the Olympic Mountains, in Washington, is attracting the attention of mining men. The Polson and Big West mines of the locality are building a trail into the district via of Howe Creek with a view of packing out high-grade gold-silver-copper ore which is reported as averaging around $300 per ton.

Nickel in Iron Creek Mine

A 60-ft. vein of nickel ore has been discovered and is being developed on the property of the Iron Creek Mining Co. operating near Keller. The vein or dike is reported as carrying ore averaging 2 per cent nickel, according to J. E. Kennedy, manager.

MONTANA

Good Ore at Caroline

From Caroline, a small mining camp about eighteen miles southeast of Butte, come reports that a 4-ft. vein assaying 9 per cent copper, 14 oz. silver, 27 per cent lead and $3 in gold was recently cut in one of the many prospects in the districts. Drifting will be started immediately, and if values hold out much activity will be seen in the old camp during the summer.

MICHIGAN

Seneca Should Produce in Sixty Days

Seneca, in the copper district, will begin production within sixty days. While the main shaft is being prepared for mining operations, splendid progress is being made in the sinking and drifting in the Gratiot branch. Territory to the south of Gratiot shaft, toward the Mohawk boundary, is disclosing highly mineralized ground in the 9th, 11th and 14th level drifts. The rock is similar in character to that opened in the 13th. The 13th level drift, north, is showing improvement and is getting into better copper ground. To the south, the drift has been pushed to the Mohawk boundary, in commercial vein matter all the way. Installation of surface equipment at both shafts is rapidly nearing completion, and steady progress is being made in putting in raises at the several levels in Seneca shaft.

Arcadian Shaft Bottomed at 1,850 Ft.

The new Arcadian shaft of the Arcadian Consolidated Company, which is being reopened, will be sunk an additional 1,150 ft. to the 3,000 level. It is now bottomed at 1,850 ft. This operation will require nine months, sinking at the rate of 125 ft. per month. This includes the complete equipment of the shaft, the timbering, shipway, ladderway, and piping being installed as fast as the shaft is lowered, special equipment having been provided for that purpose. The shaft is supplied with a hoist of 5,000 ft. capacity and a twenty-drill compressor.

Lightning Delays Work on Gogebic Range

During the week frequent and severe electrical storms have interrupted power service on the Gogebic range from the public service company, and even the plant of the Oliver Iron Mining Co., which is generally free from trouble due to lightning because its current is distributed to seven shafts through a system of underground conduits, was closed down for five hours. This was due to interruption of the water supply to the boilers when an electric pump at the river was burned out.

No Marked Shortage of Miners

The labor situation on the Gogebic Range is better than had been expected earlier in the year. There is no surplus of labor, but neither is there any great shortage. Some married men who had gone to the automobile centers have returned to the mines on account of the great difficulty of obtaining any kind of living quarters in the cities.

Empire Iron Mine to Resume

The M. A. Hanna Co. is to resume mining operations at the Empire property, an open pit in the Cascade field, Marquette range. It is a producer of low-grade silicious ore, which is in good demand this year. The company also operates the Richmond, close by, which is a heavy shipper at present.

JOPLIN-MIAMI DISTRICT

Schwab "Entry" Pleases Operators

Local interest centers in the merging of the Tom L. and Chubb mines with Quapaw Mining Co., which is one in which Charles M. Schwab has controlling interest. The Tom L. mine is located southwest of Picher and Chubb is northwest, across the line in Kansas. Both properties are considered unusually good, the Chubb alone having shipped 3,084 tons of zinc concentrates and 315 tons of lead ore in the 15 weeks it has been in operation, having been opened up only this spring. T. F. Lennan, one of this district's best known operators, was head of the two properties and will continue as manager for the Quapaw Co. H. W. Lohman, who is the financial agent for the Schwab interests in Oklahoma will continue in charge of the operators of the Quapaw Co. around Quapaw, where the company has 2,200 acres of leases. Consensus of opinion in the Joplin-Miami district is that this marks the formal entry of Schwab into this district in a big way, with a possibility that it will mean much for the field.

Federal Closes Kansouri Lease

After drilling approximately 100 holes on the Kansouri lease, near Treece, the Federal M. & S. Co. has closed the working option it held on the acreage. According to P. W. George, manager for the Federal Co. in the field, more drilling will be done before full development operations are started. The lease already has a well equipped mill so that production can be started as soon as sufficient ore is proved.

St. Louis No. 2 Mill Restarted

The St. Louis Smelting & Refining Co. has just placed in operation once more its No. 2 mill, at St. Louis, Okla., after it had been idle for approximately two years. A new field shaft is being sunk about a quarter of a mile east of the mill. Charles Schwarz is manager.

New Concentrator Nears Completion

The Freehold Oil & Gas Co. is rapidly completing a new concentrator on its No. 4 lease, near Waco, Mo., and will have it in operation, it is believed, before the middle of July. The lease has been well drilled. The company also recently completed the sinking of a field shaft at its No. 2 property from the 185 ft. level to 205 ft. where a much richer orebody was encountered. Snowden Marquis, of Webb City, is manager for the company.

Toltec Changes Hands

J. W. Hoffman and associates have purchased the Toltec mine, south of Hockerville, from R. L. Kidner and Herbert Wilson. The purchase price is reported at $25,000. Hoffman formerly managed the Blue Mound and Blue Diamond properties, north of Picher, for several years heavy producers.

The Toltec mine was first opened up three years ago by the Prospectors Mining Co., which sold it some months later to H. G. Larsh and associates. Mr. Larsh in turn sold it to Wilson and Kidner this spring, and the latter operators opened up a good run of lead.

Vantage Wins Suit Started by Bankers

The Vantage Mining Co. recently was awarded a decision in a suit against it by several Oklahoma banks, which involved $85,000 worth of stock of the company and profits of the mine. The case of the plaintiffs rested on a reputed agreement between certain officers of the mine as to the disposition of a portion of the stock, and this agreement was declared as against public policy and void or voidable by the defendants, by Special Judge H. L. Shannon, in the Miami district court. It is expected the case will be appealed. An interesting disclosure of the testimony in the case was that the Vantage Co. has paid 440 per cent in dividends on a capital stock of $150,000 since July 1, 1919.

ARKANSAS

Ohio Mine, Near Yellville, Is Producing

The Ozark Mining Co., of Vinita, Okla., has been developing the Ohio mine, near Yellville, and is producing high-grade zinc-carbonate ore. The main tunnel is driven into the mountain 300 ft. The recovery from the average "dirt" is 10 per cent of concentrate. The mill is of 100-ton capacity. From fifteen to twenty men are employed. Concentrates are shipped to the Grasselli Chemical Co., at Cleveland, Ohio.

Big Hurricane Will Operate

Addison E. Mullikin and Francis T. Homer, trustees, have recently received a decree of foreclosure of a mortgage given by J. C. Shepherd on the Big Hurricane property and bought in the property for the sum of $43,000, the balance due them on the mortgage. This mine is one of the best in the Yellville district. Two large concentrating plants have been erected to treat the ores, and the owners are making preparations to resume operations.

Power Development Will Help Mining

The development of hydro-electric power in the Yellville district will give the mining industry a great boost. The Dixie Power Co., headed by Walker Powell, has secured permits from the Federal Power Commission to develop power on the principal streams of the Ozark Mountains, the White, Buffalo and Northfork rivers. The principal dam of the system will be across White River near Cotter. It is to be 250 ft. high, and will create a reservoir extending from the dam to the foot of the Powersite dam, in Taney County, Mo., a distance of over 100 miles. Hugh L. Cooper & Co., of New York, has secured an option on the stock of the Dixie Power Co. and has a force of engineers in the field carefully checking the original surveys.

THE MARKET REPORT

Daily Prices of Metals

June	Copper, N. Y. net refinery* Electrolytic	Tin 99 Per Cent	Tin Straits	Lead N. Y.	Lead St. L.	Zinc St. L.
21	14.75	39.625	40.125	7.00	6.80	5.85@5.90
22	14.625@14.75	39.875	40.50	7.00	6.70@6.80	5.80@5.85
23	14.625@14.75	40.00	40.50	7.00	6.70@6.75	5.80@5.85
25	14.50@14.625	40.00	40.625	7.00	6.70@6.75	5.75@5.85
26	14.375@14.50	39.75	40.25	7.00	6.65@6.70	5.70@5.85
27	14.375	38.875	39.25	7.00	6.65	5.70@5.80
Av.	14.583	39.688	40.208	7.00	6.721	5.808

*These prices correspond to the following quotations for copper delivered: June 21st, 15.00c.; 22d and 23d, 14.875@15.00c.; 25th, 14.75@14.875c.; 26th, 14.625@14.75c.; 27th, 14.625c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. The quotations are for prompt deliveries. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

The quotations are arrived at by a committee consisting of the market editors of *Engineering and Mining Journal-Press* and a special representative of the Bureau of Mines and the Bureau of Foreign and Domestic Commerce.

London

June	Copper Standard Spot	Copper Standard 3M	Copper Electrolytic	Tin Spot	Tin 3M	Lead Spot	Lead 3M	Zinc Spot	Zinc 3M
21	66	66 1/2	73	187 3/4	188 1/8	25	24 3/8	28 5/8	29
22	66	66 3/8	73	188 1/4	188 3/8	25	24 3/8	28 1/4	28 7/8
25	65 3/4	66 1/4	72 1/2	188 3/4	189 3/8	25 1/8	24 3/8	28 1/2	28 3/4
26	65 1/4	65 3/4	72	186 3/4	187 3/4	25	24 1/4	28	28 1/2
27	64 7/8	65 3/8	71 1/2	182 5/8	183 5/8	24 3/4	24 1/8	27 5/8	28 1/8

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

June	Sterling Exchange "Checks"	Silver New York	Silver London	Gold London	June	Sterling Exchange "Checks"	Silver New York	Silver London	Gold London
21	4.61 1/4	64 1/4	31 5/16	89s. 3d.	25	4.60 7/8	64 1/8	31 1/4	89s. 3d.
22	4.61 1/4	64 1/2	31 1/2	89s. 4d.	26	4.60 7/8	64 1/8	31 1/4	89s. 4d.
23	4.61 1/4	64 1/4	31 5/16	....	27	4.60 1/2	63 7/8	31 1/8	89s. 5d.

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-quarter of a cent premium.

Metal Markets

New York, June 27, 1923

Metal prices have exhibited marked declines in the weak market of the last few days. Consumers continue to remain aloof, and though sales have generally been somewhat larger than last week, most of the buyers are showing little interest and only picking up such lots as seem particularly cheap.

Copper

Most of the larger producers still adhere to the 15c. level, and whether they will reduce their price below this or not remains to be seen. It is purely a nominal quotation and this price has not been realized, except on an occasional carload, since Saturday. Some of the inquiries have been for small tonnages for prompt shipment but there seems to be an aversion to buy for other than immediate requirements except at marked concessions. The reduced prices at which some custom smelters have been willing to do business only hold for comparatively large lots. It is encouraging to note that some large buyers have taken substantial tonnages at 14.625@14.75c., delivered, indicating that they think copper a good buy at those levels. Should a buying movement of even moderate dimensions set in, the amount of copper available below the nominal quotations of most of the producers would be taken up quickly.

The export market has also been unsatisfactory during the week, though one good sized order was received this morning. Germany has taken nothing, and the other European countries only moderate amounts. The price, however, has been from one-eighth to one-quarter cent above that realized on domestic business.

As has been said before, consumption continues at an excellent rate, but supplies seem to be adequate for immediate requirements, and in a falling market it is against human nature to buy ahead.

Lead

The official price for lead of the American Smelting & Refining Co. was reduced from 7.25c., New York, to 7c. late Thursday afternoon, June 21. The reduction was caused by the fact that weakness in the foreign market again made importation possible.

The lower price increased buying in the East somewhat though the market has certainly not been active. Producers are well sold up with current production however, and specifications continue good, so that there is no pressure to sell below the level of the Smelting company.

The St. Louis market has again been depressed to the point where the exact freight differential between St. Louis and New York obtains. Most of the producers have kept on the upward side of the market but lower quotations have been made by at least one seller who is anxious to get rid of supplies. Desilverized lead was offered as low as 6.75c. in Chicago as early as Monday.

Zinc

Again under the lead of London, and with an almost entire absence of demand on this side, prices have declined further. There has been an occasional galvanizing inquiry, but the immediate needs of this class of consumers seem to be well supplied. Plenty of June zinc is available and in the last two or three days prompt deliveries have gone begging at 5.70@5.75c. whereas August and September zinc has brought 5.85c. With the price of ore today at $32, it is not profitable to smelt with zinc prices much under 5.90c.; it is better business for smelters to buy the metal in the open market for promised deliveries. Stocks are without doubt continuing to increase, and every one is waiting to see who will be compelled to close down first so that the rest will be permitted to live. High-grade zinc continues in

good demand at unchanged prices, 8.50 @9c. delivered in the East.

Tin

The tin market continues a very listless affair though the decline in price today, which brought Straits definitely below the 40c. level, has inspired some consumers to enter the market to a little greater extent than recently. The 99 per cent grade is still held very tightly. Forward deliveries of Straits have been quoted at one-half cent less than spot.

Arrivals of tin, in long tons: June 19th, Straits, 130; 20th, Australia, 10; Java, 80; 22d, Straits, 250; Liverpool, 150; 23d, Straits, 550; 25th, Straits, 800; China, 75; Liverpool, 100; 26th, Liverpool, 10; Straits, 600; total so far in June, 4,465.

Silver

Buying by the Indian bazaars has continued both in London and New York, but the demand from this quarter was not sufficient to withstand the pressure of sales from China and the Continent, with the result that the price has declined slightly.

Mexican Dollars—June 21st, 49; 22d, 49¼; 23d, 49; 25th, 48⅞; 26th, 48⅞; 27th, 48¾.

Money Stocks

Stock of money in the United States, June 1: Gold coin and bullion, $4,023,250,195; standard silver dollars, $491,299,404; subsidiary silver, $268,554,102; United States notes, $346,681,016; Federal Reserve notes, $2,612,962,950; Federal Reserve Bank notes, $23,868,000; National Bank notes, $770,007,992; total, $8,536,623,659. Circulation per capita, $42.34.

Foreign Exchange

On Tuesday, June 26, cable quotations on francs were 6.13c.; lire reached a new low for the year and closed at 4.44c.; marks, 0.007c.; and Canadian dollars, 2½ per cent discount.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

Aluminum—99 per cent grade, 26@27c. per lb.; 98 per cent, 25@26c. London £115, 98 per cent.

Antimony — Chinese and Japanese brands, 6.875@7c. per lb. W.C.C., 7.50c. Cookson's "C" grade, spot, 10@10½c. Market continues inactive.

Bismuth—$2.55 per lb. London, 10s.

Cadmium—$1 per lb. London, 5s.

Cobalt—$3 per lb.

Iridium—$275@$300 per oz.

Nickel—27@32c. per lb. for 99 per cent virgin metal. London, £130@£135 per long ton.

Palladium—$80@$81 per oz.

Platinum — $116 per oz. Market much firmer and some quotations as high as $118 heard. London, sponge, £22½; manufactured, £24½.

Quicksilver—$67@$68 per 75-lb. flask. Quiet. San Francisco wires $66.50. London, £10 15s.

Tellurium—$2 per lb.

Thallium—$10 per lb. in 25-lb. lots.

The prices of **Magnesium, Molybdenum, Monel Metal, Osmium, Radium, Rhodium, Selenium,** and **Tungsten** are unchanged from prices given June 9.

Metallic Ores

Chrome Ore — Indian chrome ore, $20.50 per ton, c.i.f. Atlantic ports. Rhodesian $22 and New Caledonian, $24@$25, nominal.

Tungsten Ore—Wolframite, $8.75@$9; scheelite, $8.50@$9 per unit of WO_3.

Iron Ore, Magnesite, Manganese, Molybdenum, Tantalum, Titanium, Uranium, Vanadium, and **Zircon Ore** are unchanged from the quotations published June 9.

Zinc and Lead Ore Markets

Joplin, Mo., June 23—Zinc blende, per ton, high, $37.25; basis 60 per cent zinc, premium, $33; Prime Western, $33@$32; fines and slimes, $32@$30; average settling price $35.37.

Lead, high, $94.50; basis 80 per cent lead, $90@$80; average settling price, $91.95 per ton.

Shipments for the week: Blende, 11,324; lead, 2,075 tons. Value, all ores the week, $592,920.

American Smelting and Refining Company's reduction to 7c. reduced offerings on lead ore $10 per ton the latter half-week, for ore purchased for later delivery.

The production of zinc ore has declined from the peak production of 16,000 tons a week in April to less than 12,000 tons the past week. It has reached the level of shipments and this indicates there will be no further increase in reserve stocks of ore in the bins, and the larger part of the reserve tonnage is being withheld from the market, on present price offerings.

Platteville, Wis., June 23 — Blende, basis 60 per cent zinc, $37 per ton. Lead, basis 80 per cent lead, $92 per ton. Shipments for the week: Blende, 548 tons; lead, none. Shipments for the year: Blende, 16,982; lead, 340 tons. Shipments for the week to separating plants, 792 tons blende.

Non-Metallic Minerals

Fluorspar—Imported spar, fluxing grade, 85 per cent CaF_2, $8.50@$13 per net ton, c.i.f. New York, in bond; enamel grade, 95 per cent plus, $18@$19, do.; acid grade, 97½ per cent plus, $22@$23, do. Duty, $5.60 per gross ton. Market active but resistant to higher prices. Other prices unchanged from those reported June 9.

Asbestos, Barytes, Bauxite, Borax, Chalk, China Clay, Diatomaceous Earth, Emery, Feldspar, Fuller's Earth, Graphite, Gypsum, Limestone, Magnesite, Manjak, Mica, Monazite, Phosphate, Pumice, Pyrites, Silica, Sulphur, Talc, and **Tripoli** are unchanged from the June 9 prices.

Mineral Products

Arsenious Oxide (white arsenic)—13½c. per lb. for prompt. July, 12c. Second half 1923, 11c.

Copper Sulphate — Large crystals, 5.60c.; small, 5.50c. for domestic. Imported bluestone as low as 4.50c.

Sodium Nitrate — $2.45@$2.52½ per 100 lb.

Potassium Sulphate and **Sodium Sulphate** are unchanged from quotations of June 9.

Ferro-Alloys

Ferrocerium—$7 per lb.

Ferromanganese — Domestic 78@82 per cent, $125 per gross ton, f.o.b. furnace. Spiegeleisen, 19@21 per cent, $45@$47.50, f.o.b. furnace; 16@19 per cent, $44@$46.50.

Ferromolybdenum—$2 per lb. of contained molybdenum for 50@55 per cent grades.

Ferrotungsten—88@90c. per lb. of contained tungsten, f.o.b. works.

Ferro-uranium — 35@40 per cent U, $4.50 per lb. of U contained.

Ferrochrome, Ferrosilicon, Ferrotitanium and **Ferrovanadium** are unchanged from the prices published June 9.

Metal Products

Rolled Copper—Sheets, 24.25c., base; wire, 18c.

Zinc Sheets—Base price 8.90c. per lb. f.o.b. La Salle, Ill.

Lead Sheets, Nickel Silver and Yellow Metal are unchanged from the prices given in the June 9 issue.

Refractories

Bauxite Brick, Chrome Brick, Chrome Cement, Firebrick, Magnesite Brick, Magnesite Cement, Silica Brick and **Zirkite** are unchanged from the June 9 prices.

The Iron Trade

Pittsburgh, June 26, 1923

Although deliveries of steel continue to be well taken by jobbers and manufacturing consumers, there being no postponements or cancellations of any consequence, the situation has been much aided by hot weather, which has curtailed production. The automobile industry, which is probably covered a less distance ahead in steel than any other important consuming line, is buying in a conservative way for the third quarter, and will have but little decrease in steel consumption. Steel buying on the whole has been very light, much lighter than in the fore part of June, and the dullness promises to continue through July and at least part of August.

Finished steel prices are very firm, at rates ruling for two months or more, or since the last advances. Semifinished steel has been declining, billets and sheet bars being easy now at $42.50.

Pig Iron—The market is extremely dull, not enough being done to fix prices closely. Foundry is obtainable at $27, Valley, or $1 decline in the week. Last important sales of basic were at $27.50, but there is resale iron offered at $26. Bessemer is nominal at $28.50, Valley.

Connellsville Coke—Good brands of furnace coke are now offered at $5.25 for third quarter without finding takers. Spot is easy at $5. Spot foundry is off 25c. at $5.50@$6.

COMPANY REPORTS

Greene Cananea Copper Co.

Copper, Silver; Cananea, Son., Mexico

The combined balance sheet of the Greene Cananea Copper Co. and the Cananea Consolidated Copper Co., S. A., for the year ended Dec. 31, 1922 follows:

Assets

Fixed:		
Mines and mining claims, lands, railways, buildings and equipment	$52,146,215.09	
Investments in sundry companies	68,601.00	$52,214,816.09
Current:		
Supplies and prepaid expenses	$1,488,830.64	
Metals in process and on hand, at the lower of cost or market	949,978.48	
Accounts receivable	227,891.79	
Cash and cash assets	278,697.25	2,945,398.16
		$55,160,214.25

Liabilities

Capital stock:		
Authorized—600,000 shares at $100 each		
Issued—500,000 shares		$50,000,000.00
Reserves:		
For depreciation	$546,733.88	
Mexican legal reserve	4,000.00	550,733.88
Current:		
Accounts and wages payable and taxes accrued		639,830.55
Surplus:		
Balance Dec. 31, 1921	$5,429,296.38	
Net loss year ending Dec. 31, 1922	1,459,646.56	3,969,649.82
		$55,160,214.25

Income Account

Income:		
Sales of metals		$2,369,118.44
Miscellaneous receipts		125,011.89
		$2,494,130.33
Expenses:		
Mining	$1,277,864.30	
Reduction	848,157.63	
Refining and selling	219,444.70	
Administration and taxes	213,813.10	
Metals in process and on hand at beginning of year	1,451,844.91	
	$4,011,124.64	
Metals in process and on hand at end of year	949,978.48	3,061,146.16
		$567,015.83
Expenditure on buildings and equipment written off		540,793.36
		$1,107,809.19
Interest received		15,694.95
Operating loss		$1,092,114.24
Expenditure during suspension of operations		367,532.32
Balance—net loss for the year		$1,459,646.56

The plant was closed down for nineteen months and resumed Aug. 26, 1922. During the four months of operations the company produced from its own and purchased ores, 10,577,387 lb. of copper, 398,359 oz. of silver, and 2,487 oz. of gold. Production at present is about 3,500,000 lb. of copper per month. The cost of refined copper for 1922 including all expenses chargeable against production was 18.268c. per lb. There is a disagreement about the income taxes due to the U. S. Government for 1917 and 1918 and it may be that the amount paid will be declared in a large measure insufficient, owing to the amount of invested capital claimed by the company being considerably larger than the Government is disposed to allow.

There was mined during the year 96,256 wet tons of concentrating ore and 219,600 wet tons of direct-smelting ore; also 105 tons of zinc ore. The average cost of mining copper ore was $3.3266 per ton. Little change in the ore reserves has occurred. The concentrator treated 91,220 dry tons of ore, the ratio of concentration being 3.29 to 1 and the cost per ton of ore concentrated, $1.1917. New copper-bearing material to the amount of 224,797 dry tons was smelted at a cost of $3.059 per ton.

Officers: W. D. Thornton, president; L. D. Ricketts and Wm. Wraith, vice-presidents; J. W. Allen, secretary and treasurer; W. S. Harper, asst. secy. and asst. treas.; J. B. Cotton, general counsel. Directors: J. W. Allen, P. L. Foster; J. W. Harriman, Walter Douglas, W. E. Corey, L. D. Ricketts, W. D. Thornton, Wm. Wraith, J. B. Cotton. General office, 25 Broadway, New York City.

Quincy Mining Co.

Copper; Hancock, Mich.

The directors submit the following report of the business and operations of the Quincy Mining Co. for 1922.

The mine yielded 15,402,726 lb. of refined realized copper, for which has been		$2,159,034.88
Profits on silver		73,571.34
		$2,232,606.22
Mining expense	$1,671,295.16	
Opening mine expense	171,189.65	
Taxes paid in Michigan	102,748.33	
Capital stock tax	8,313.00	
Smelting and transportation, etc.	254,998.46	
		2,208,544.60
		$24,061.62
Other receipts		16,009.14
Total		$40,070.76
Construction	$81,883.64	
Accident account	24,000.00	
		105,883.64
Deficit		$65,812.88

The statement of assets and liabilities in the last report showed a balance on hand:

Jan. 1, 1922	$1,611,320.84
Deficit for 1922	65,812.88
Balance of assets Jan. 1, 1923	$1,545,507.96

The loss for the year was due entirely to the increased cost of producing copper during the last half of the year through the shortage of underground labor, caving of No. 6 shaft in July, cost of repairs to the shaft, and the higher price for coal due to the coal strike, as operations were conducted at a slight profit during the first half of the year.

Underground conditions continue favorable, with a good showing for copper in the deepest openings, and there was a slight increase in the yield of refined copper per ton of ore hoisted during the year.

The copper was sold at an average of slightly over 14c. The recovery of silver was 150,139 fine ounces, all of which was sold to the government under the Pittman Act on the basis of $1 per oz., netting a profit of $73,571.34.

During the year the mine produced 674,499 tons of copper ore and mass copper which yielded 22.83 lb. of refined copper per ton. A total of 1,786,140 lb. was recovered by the regrind section of the stamp mill.

The combined lineal feet of development throughout the mine was about two and one-half miles. The ground developed by this extension of the bottom of the mine as it became deeper, is of an equal or better tenor of copper ore and mass copper than that immediately above.

Operations at the stamp mills were confined to No. 1 mill, with an average for the year of approximately four heads running; No. 2 mill remaining idle.

The capital stock is $3,750,000 in 150,000 shares of $25 each, of which 110,000 have been issued.

Officers: W. R. Todd, president; W. P. Todd, vice-president; W. A. O. Paul, secretary and treasurer. Office, 52 Broadway, New York.

Howe Sound Co.

Copper, Silver, Lead; British Columbia and Mexico

The Howe Sound Co. holdings remain unchanged, consisting of all of the capital stock of the Britannia Mining & Smelting Co., Ltd., and of the Calera Mining Co., and 53,800 out of 60,000 shares of El Potosi Mining Co. The combined balance sheet for the year ended Dec. 31, 1922, is given in the annual report as follows:

Assets

Fixed:		
Mining property	$8,027,829.75	
Plant, buildings, and machinery	6,275,027.31	
Investments	1,002,928.02	$15,305,785.08
Deferred charges		523,965.33
Reserve fund		195,302.02
Current:		
Inventories	$515,044.78	
Accounts receivable	110,893.72	
U. S. and Canadian, and other bonds	2,274,523.15	
Cash on hand	94,257.68	2,994,719.33
		$19,019,771.76

Liabilities

Capital stock:		
Authorized, 3,000,000 $1 shares of which 1,984,150 have been issued		$1,984,150.00
Twenty-year six per cent gold bonds, Jan. 1936:		
Outstanding Dec. 31, 1921	$3,766,000.00	
Redeemed, Oct. 1922	269,000.00	3,497,000.00
Reserves:		
For depreciation and depletion	$7,067,526.38	
For insurance	588,452.81	
For workmen's compensation, etc	17,875.04	7,673,854.23
Profit and loss:		
Balance on Dec. 31, 1921	$3,221,349.42	
Adjustment previous year's depreciation and depletion	1,585,805.96	
Adjusted balance	$4,807,155.38	
Profit for 1922	226,062.82	5,033,218.20
Current liabilities:		
Accounts payable	$294,549.33	
Notes payable	537,000.00	831,549.33
		$19,019,771.76

Profit and Loss Account

Mining		$663,702.72
Transportation, mine bins to smelter		127,098.56
Milling (experimental work)		5,614.61
Smelting and marketing (inc. Mexican export duty)		1,186,522.96
Extraordinary		43,322.63
Administration, general and legal expenses		120,234.05
Taxes		136,394.26
Balance		996,559.78
		$3,278,449.57
Depreciation and depletion		609,921.96
Interest		160,575.00
Balance		226,062.82
		$996,559.78
Smelter returns:		
On 3,289,347 oz. silver and 26,218,950 lb. lead		$3,064,765.99
Miscellaneous income		213,683.58
		$3,278,449.57
Balance brought down		996,559.78

The Voting Trust Agreement has been extended to Jan. 3, 1927. Large expenditures were made for the erection and equipment of the Britannia mill which was completed in February, 1923. Operations at the El Potosi continued uninterrupted throughout the year and new equipment to increase the capacity was installed. No work was done at the Calera property pending the development of proper metallurgical methods for treating the ore. Operations in British Columbia were confined to mine development, and rebuilding. The ore reserves of the Britannia mine total 6,931,240 tons averaging 2.10 per cent copper; of this tonnage 1,524,750 tons is broken in stopes. A contract has been made for steamship transportation of the concentrates to the Tacoma smelter. Additional power has also been contracted for, to be ready by September, 1923.

At El Potosi, 229,367 dry tons were mined and shipped, the largest tonnage in the history of the mine, all going to the smelter at Morse Station. A 50-ton pilot mill has just been completed for experimental work on El Potosi and Calera ores.

Officers: Evander B. Schley, president; W. H. Gelshenen and W. J. Quigly, vice-presidents; W. J. Walworth, vice-president and secretary; Emil Richter, treasurer and assistant secretary. Directors: E. B. Schley, H. M. Hanna, Jr., W. H. Gelshenen, G. H. Howard, K. B. Schley, C. E. Dunlap, Reeve Schley, G. B. Schley, C. G. Raynor, W. J. Quigly in charge of operations. General office 665 Fifth Ave., New York City; after July 15, 1923, 730 Fifth Ave.

Callahan Zinc-Lead Co.

Zinc, Lead; Interstate, Idaho

A report of the operations of the Callahan Zinc-Lead Co. for the first quarter of the year 1923 follows:

Net value of shipments	$347,435.58
Miscellaneous income	15,672.38
Total income	$363,107.96
Production costs, expenses and development	309,915.63
Operating profits	$53,192.33
Improvements and new equipment	4,853.03
Surplus for the period	$48,339.30

The principal features of the mining and milling operations during the quarter were as follows:

Tonnage mined		56,763
Tons of mine ore milled		42,359
Average contents of ore milled:	Zinc, per cent	11.10
	Lead, per cent	6.57
	Silver, oz	2.16

Shipments	Dry Tons	Zinc Assay	Lb. Zinc	Lead Assay	Lb. Lead
Lead concentrate	3,231	13.86%	895,767	57.40%	3,709,237
Zinc concentrate	5,745	51.16%	5,878,616	4.39%	504,946
	8,976		6,774,383		4,214,183

Mill recovery of zinc, per cent	71.01
Ounces of silver in lead concentrates	62,805
Cost of mining, crushing and sorting, per ton mined	$3.548
Cost of milling and flotation royalties, per ton milled	$1.762

Tonopah Belmont Development Co.

Silver; Tonopah, Nev.

The condensed statement of operations of the Tonopah Belmont Development Co. for the quarter ended March 31, 1923 follows:

Received and receivable for ore	$338,333.39
Mining, milling and administration	281,329.75
Net earnings for three months	$57,003.64
Miscellaneous income	4,379.89
Total net income for 3 mo. ended March 31	$61,383.53

Available resources, May 31, 1923

Due from smelter	$308,881.91
Due from others	125,287.10
Cash in banks	27,353.12
U. S. Treasury notes	100,000.00
Liberty bonds	50,031.25
	$611,553.38

The net earnings for the quarter ended March 31, of the Belmont Surf Inlet Mines, Ltd., of which the Tonopah Belmont owns 80 per cent, were $14,889.49.

Barnes-King Development Co.

Gold; Marysville, Mont.

The records of the Barnes-King Development Co. show the following operating results for the quarter ending March 31, 1923:

Earnings		
Interest		$934.36
Deduct		
Shannon property expense less net bullion receipts	$9,360.56	
North Mocassin property expense	1,242.80	
Piegan-Gloster property expense	762.63	
Kendall property expense less power plant lighting	586.40	
Miscellaneous	4,206.13	
		16,158.52
Difference being loss on operations for quarter ending March 31, 1923		$15,224.16

The above figures include provisions for depreciation on the various plants of the company on the same basis as has been used heretofore.

"Owing to the unsettled conditions due to the frequent changes in rulings by the Mint and the consequent delay in receipt of cash for bullion produced, and the suspension of all purchases under the Pittman Act until after June 15, 1923, with the probability that none will be made after that date, your management deems it unwise to declare a dividend at the present time."

Mining Dividends Increase in June

The following dividends were paid by mining and metallurgical companies in June:

Companies in the United States	Situation	Per Share		Total
Ahmeek, c	Mich.	$1.50	Q	$300,000
American Metal	U. S. and Mex.	.75	Q	402,000
American Metal pfd	U. S. and Mex.	1.75	Q	87,500
American Smelting & Refining pfd	U. S. and Mex.	1.75	Q	875,000
Calumet & Arizona, c	Ariz.	1.00	Q	642,522
Calumet & Hecla, c	Mich.	10.00	Q	1,000,000
Federal Mining & Smelting pfd. s.l	Idaho	1.75	Q	210,000
Hecla Mining, s.l	Idaho	.50	Q	500,000
Homestake, g	S. D.	.50	M	125,580
Inland Steel	Minn.	.625	Q	629,379
Isle Royale, c	Mich.	.50	Q	75,000
Mohawk, c	Mich.	1.00	Q	100,000
National Lead	U. S.	2.00	Q	413,108
National Lead pfd	U. S.	1.75	Q	426,433
Osceola Consolidated, c	Mich.	1.00	Q	96,150
St. Joseph Lead	Mo.	.50	Q	774,684
Tamarack & Custer, s.l	Idaho	.02	Q	100,000
Texas Gulf Sulphur	Texas	1.50	Q	952,500
Tintic Standard, s.l	Utah	.15	Q	176,205
U. S. Steel	U. S.	1.25	Q	6,353,781
United Verde Copper	Ariz.	2.00	Q	600,000
Utah Apex, s.l	Utah	.50		264,100
Utah Copper	Utah	1.00	Q	1,624,490
Companies outside of the United States				
Chile Copper	Chile	.625	Q	2,375,000
Hollinger Consolidated Gold	Ont.	.05	4 wks.	246,000
Lucky-Tiger Combination, g	Sonora	.07	M	50,074
Mexico Mines of El Oro, s.g	Mexico	10 sh.		£105,000
Oroville Dredging, g	Colombia	9d.	Q	26,836

Q, quarterly; M, monthly; c, copper; l, lead; g, gold; s, silver.

The record shows an improvement over the previous quarterly disbursements. Ahmeek paid $1.50 a share instead of $1; Calumet & Hecla $10 instead of $7; Hecla Mining 50c. instead of 25c.; Inland Steel 62½c. instead of 25c.; Texas Gulf Sulphur $1.50 instead of $1.25; Tintic Standard 15c. instead of 10c.; United Verde $2 compared with $1.50 before; and Utah Apex paid a dividend for the first time since January, 1920. In addition to the companies given in the above list, the California Rand Silver paid a dividend, the amount of which we have been unable to learn. No dividend is reported by the West End Consolidated this month, and it is probable that resources are being conserved owing to the cessation of buying of $1 silver. The exceptionally rich Keeley silver mine, in South Lorrain, Ontario, has decided to make payments semi-annually, which is said to be in accordance with English custom.

French Metal Markets Continue Inactive

SPECIAL FOREIGN CORRESPONDENCE

The industrial demand for copper continues quiet, and the market is restricted. A fall of prices is expected so that buyers are not providing for future requirements more than necessary.

The 1922 report of the Société des Mines et Usines de Cuivre de Chanaral, operating in Chile, shows a loss of 2,178,000 fr. Of this, 932,960 fr. was caused by damage to the company's plant through the tidal wave of last November. The question of transferring this mine and plant to an American group is still in abeyance.

Lead purchasing in France is quiet owing to the persistent slackness in the building trades. France is consuming an important tonnage of American lead of the Perth Amboy brand, which reaches this country more quickly than the Mexican product.

For the first time, iron ore from Briey district, running from 35 to 38 per cent iron, has been sold to Welsh blast furnaces. Negotiations to the same end were also opened with possible buyers in the United States but so far no business has been reported. However, American coke is now being received here, and French iron ore would make a good return cargo which could be smelted at furnaces on the Eastern seaboard.

Facts for the Stockholder

XXI—Callahan Zinc-Lead Co.

CALLAHAN ZINC-LEAD CO. was incorporated as the Consolidated Interstate-Callahan Mining Co., in Arizona, June, 1912. The name was changed to Callahan Zinc-Lead Co. in April, 1920. It is engaged in mining, milling, and marketing zinc and lead-silver ores. It owns outright the properties of the former Nipsic Mining Co. and the Galena Mining Co., and controls through stock ownership the Blue Grouse Mining Co., the Virginia Lode Mining Claim, and the Silver State Mining Co.

The Interstate-Callahan claims are located in the Beaver and Placer Center mining districts, in Shoshone County, Idaho, and include patented and unpatented claims aggregating about 1,250 acres.

The Callahan mine is developed by about 10 miles of underground workings. Annual development work has been performed as follows during the last five years: 5,389 ft. in 1918, 1,088 ft. in 1919, 2,338 ft. in 1920, 1,515 ft. in 1921, and 811 ft. in 1922. Ore reserves on Dec. 31, 1922 (excluding Galena or controlled properties) were estimated at about 165,000 tons, averaging 12½ per cent zinc, 6½ per cent lead and 2½ oz.. silver.. In addition, there is low-grade ore.

The main haulage level is 1,200 ft. below the mountain top, and a three-compartment shaft is sunk from this level to a depth of over 1,450 ft. Equipment includes a 250 hp. underground hoist, saw mill, oil-flotation plant and concentrator remodeled and enlarged to provide a monthly milling capacity of over 14,000 tons. A tramway operates from the concentrating plant to Sunset Station.

During the last six years the production record has been somewhat irregular, as follows: 240,858 tons mined during the eighteen months ended Dec. 31, 1917; 85,363 tons during six months in 1918; 67,952 tons during four and one-half months in 1919; 172,930 tons during ten months in 1920; and 29,234 tons during the last two months of 1922. Operations were resumed Nov. 1, 1922, after a shutdown of about two years. Since 1917 the silver assay has ranged from 2 to 2½ oz. a ton; the average lead assay was 9.63 per cent in 1917, 6.51 in 1918, 7.73 in 1919, 7.37 in 1920, and 5.87 per cent in 1922. During the same period the average zinc assay was 23.29 per cent in 1917, 19.64 in 1918, 17.17 in 1919, 14.79 in 1920, and 10.44 per cent in 1922.

During 1922 the company closed a contract with the American Smelting & Refining Co. whereby the latter was to purchase Callahan's entire output of lead concentrate for a period of five years. Also, a new contract was made with the Grasselli Chemical Co. for the purchase of Callahan's entire output of zinc concentrate for a period of two years.

Capital stock outstanding consists of 666,992 shares, par value $10. In July, 1922, stockholders authorized an increase in capital stock from $5,000,000 to $10,000,000, and in September, 1922, the executive committee decided to offer 100,000 shares of the new stock to the stockholders. Shareholders were given the right to subscribe to the new stock at par, in the ratio of one new share for each five shares held, the right expiring Nov. 20, 1922, and any stock not taken by shareholders to be sold for cash at par, or issued for additional property. The proposition to issue additional stock, made in September, 1922, has been given up. At the end of 1922 the company had about 3,500 shareholders.

The net income record has been as follows: $1,591,773 during the fiscal year ended June 30, 1915; $3,100,491 during the year ended June 30, 1916; $2,325,877 during the eighteen months ended Dec. 31, 1917; $260,289 in 1918; a deficit of $108,639 in 1919; income $266,248 in 1920; deficit $156,279 in 1921; deficit $150,261 in 1922.

The dividend record since organization is as follows: $5.50 a share in 1915, $6 in 1916, $2 in 1917, $1.75 in 1918, nothing in 1919, $2 in 1920, none since. Last payment was 50c. a share Dec. 30, 1920. Total payments $7,721,688.25,

On Dec. 31, 1922, current assets were $1,175,074, against current liabilities of $76,115, leaving net working capital at $1,098,959.

Price range of stock during the last five years: High, 23 in 1919; low, 3¾ in 1921; closing price 5¾, June 27, 1923.

INVESTIGATOR.

MINING STOCKS

Week Ended June 23, 1923

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Ahmeek	Boston	62½	60	62	June 23, Q	$1.50
Alaska-Br. Col.	N. Y. Curb	2	1¾	1¾		
Allouez	Boston	21	19	21	Mar. '19	1.00
Anaconda	New York	44½	39½	41½	Apr. '23, Q	0.75
Arcadian Consol.	Boston	1⅛	1	1¼		
Ariz. Com'l.	Boston	10⅜	9⅛	10	Oct. '18, Q	0.50
Calaveras	N. Y. Curb			2		
Calumet & Arizona	Boston	51	49	49½	Mar. '23,	1.00
Calumet & Hecla	Boston	379	371	375	June '23, Q	10.00
Centennial	Boston	9	9	9	Dec. '18, SA	1.00
Cerro de Pasco	New York	42½	38⅜	41	May '23,	1.00
Chile Copper	New York	26⅜	24⅛	25⅜	Mar. 23,	0.62½
Chino	New York	22	17	21½	Sept. '20, Q	0.37½
Con. Coppermines	N. Y. Curb	3	2½	2⅞		
Copper Range	Boston	32⅜	31½	32	May '23, Q	1.00
Crystal Copper	Boston Curb	1¼	1 1/16	1 1/16		
Davis-Daly	Boston	3⅜	2⅜	2⅜	Mar. '20, Q	0.25
East Butte	Boston	6½	5⅜	6½	Dec. '19, A	0.50
First National	Boston Curb	*45	*36	*39	Feb. '19, SA	0.15
Franklin	Boston	†1½	†*45	*40		
Gadsden Copper	Boston Curb	*75	*60	*75		
Granby Consol.	New York	23	18	21½	May '19, Q	1.25
Greene-Cananea	New York	23⅜	15	22½	Nov. '20, Q	0.50
Hancock	Boston	†2⅜	†1¾	1⅞		
Howe Sound	N. Y. Curb	3⅜	3	3⅛	Jan. '21, Q	0.05
Inspiration Consol.	New York	32	27½	31⅜	Apr. '23, Q	0.50
Iron Cap	Boston Curb	†5½	†4	5⅜	May 23, K	0.15
Isle Royale	Boston	22	19	22	Mar. '23, Q	0.50
Kennecott	New York	36	32	34⅜	Apr. '23, Q	0.75
Keweenaw	Boston	1⅛	1	1		
Lake Copper	Boston	2½	2½	2½		
Magma Copper	New York	31½	29½	31½	Jan. '19, Q	0.50
Mason Valley	N. Y. Curb	1⅛	1⅛	1⅛		
Mass Consolidated	Boston	1⅛	1⅛	1⅛	Nov. '17, Q	1.00
Miami Copper	New York	25⅛	22½	24	May '23, Q	0.50
Michigan	Boston	1⅛	1⅛	1⅛		
Mohawk	Boston	50	47½	49¾	June '23, Q	1.00
Mother Lode Coa.	New York	9⅛	7⅛	9	Mar. '23, K	0.50
Nevada Consol.	New York	13⅜	11⅛	12⅞	Sept. '20, Q	0.25
New Cornelia	Boston	17½	16⅜	17⅛	May '23, Q	0.25
North Butte	Boston	5½	4⅜	5	Oct. '18, Q	0.25
Ohio Copper	N. Y. Curb	*6⅜	*5⅝	*5⅞		
Old Dominion	Boston	22	21	21	Dec. '18, Q	1.00
Osceola	Boston	33	30	30	Mar. '23, K	1.00
Phelps Dodge	Open Mar.	†170	†160	....	Apr. '23, Q	1.00
Quincy	Boston	30	28	30	Mar. '20, Q	1.00
Ray Consolidated	New York	12⅜	10⅛	12	Dec. '20, Q	0.25
Ray Hercules	N. Y. Curb	1⅜	1⅜	1⅜		
St. Mary's Min. Ld.	Boston	38	35	37	Mar. '23, K	3.00
Seneca Copper	New York	7⅜	6	7		
Shannon	Boston	†*75	†*60	*70	Nov. '17, Q	0.25
Shattuck Arizona	New York	7	6½	7	Jan. '20, Q	0.25
South Lake	Boston	*13	*13	*13		
Superior & Boston	Boston	1½	1⅛	1⅛		
Tenn. C. & C. cfs.	New York	9⅞	8	9⅜	Apr. '23, Q	0.25
Tuolumne	Boston	*20	*15	*20	May '13,	0.10
United Verde Ex.	N. Y. Curb	34½	32	33	May '23, Q	1.00
Utah Consol.	Boston	2	1½	2	Sept '18,	0.25
Utah Copper	New York	64½	60	62½	Mar. '23, Q	1.00
Utah Metal & T.	Boston	*76	*75	*76	Dec. '17,	0.30
Victoria	Boston	†1	†*75	1		
Winona	Boston	*80	*48	*75		
Wolverine	Boston	7⅛	7	7		
NICKEL-COPPER						
Internat. Nickel	New York	14¼	13	13½	Mar. '19,	0.50
Internat. Nickel pfd.	New York	83	82	82	May '23, Q	1.50
LEAD						
Carnegie Lead & Zinc	Pittsburgh			3½		
National Lead	New York	115½	113	115½	Mar. '23, Q	2.00
National Lead pfd.	New York	†110	†108½	111½	June '23, Q	1.75
St. Joseph Lead	New York	18⅞	18⅜	18⅜	June '23, Q,X	0.50
ZINC						
Am. Z. L. & S.	New York	10	9	10	May '20,	1.00
Am. Z. L. & S. pfd.	New York	41	35	35	Nov. '20, Q	1.50
Butte C. & Z.	New York	6⅜	5⅜	66	Mar. '23,	0.50
Butte & Superior	New York	22⅜	17½	21½	Mar. '23, Q	0.50
Callahan Zn-Ld	New York	6½	5⅜	6⅜	Dec. '20, Q	0.50
New Jersey Zn.	N. Y. Curb	152½	148	148	May '23, Q	2.00
United Zinc	N. Y. Curb	1	*76	*76		
Yellow Pine	Los Angeles	*65	*65	*65	Sept. '20, Q	0.03
SILVER						
Alvarado	N. Y. Curb	4⅞	4	4		
Batopilas Mining	New York	†½	†½	½	Dec. '07, I	0.12½
Beaver Consol.	Toronto	*34½	*34	*35	May '20, K	0.03
Candelaria	N. Y. Curb	*8	*5	*7		
Castle-Trethewey	Toronto	*25½	*24½	*25½		
Coniagas	Toronto	2.70	2.70	2.70	May '21, Q	0.12½
Crown Reserve	Toronto	*64	*60	*60	Jan. '17,	0.05
Hilltop-Nev.	N. Y. Curb.	*95	*75	*95		
Kerr Lake	N. Y. Curb			2¼	Apr. '23, Q	0.12½
La Rose	Toronto	*33	*33	*33	Apr. '22,	0.10
McKinley-Dar.-Sav.	Toronto	*17½	*17	*17½	Oct. '20, Q	0.03
Mining Corp. Can.	Toronto	2.75	2.64	2.65	Sept. '20, Q	0.12½
Nipissing	N. Y. Curb	5⅜	5⅛	5⅛	Apr. '23, Q	0.15
Ontario Silver	New York	4¼	4¼	4¼	Jan. '19, Q	0.50
Temiskaming	Toronto	†*43	†*41½	*41	Jan. '20, K	0.04

Stock	Exch.	High	Low	Last		Last Div.
GOLD						
Alaska Gold	New York	⅜	¼	¼		
Alaska Juneau	New York	1⅛	1⅛	1⅛		
Boundary Red M.	N. Y. Curb			*20		
Carson Hill	Boston	6	5⅛	5⅞		
Cresson Consol. G.	N. Y. Curb	3 7/16	3⅛	3⅛	Apr. '23 Q	0.10
Dome Mines	New York	37⅛	35½	37⅜	Apr. '23, Q	0.50
Golden Cycle	Colo. Springs	1.07	1.06	1.06	Dec. '22, Q	0.02
Hollinger Consol.	Toronto	12.90	12.30	12.80	June '23, M	0.05
Homestake Mining	New York	63¾	63½	63½	May '23, M	0.50
Kirkland Lake	Toronto	†*39	†*38	*40		
Lake Shore	Toronto	3.50	3.40	3.40	May '23, Q	0.02
McIntyre-Porcupine	New York	18⅛	17⅛	18	May '23, Q	0.25
Portland	Colo. Springs	†*40	†*35	*37½	Oct. '20, Q	0.01
Teck-Hughes	N. Y. Curb	1 1/16	1 1/16	1⅛		
Tom Reed	Los Angeles	*60	*55	*58	Dec. '19,	0.02
United Eastern	N. Y. Curb	1⅛	1⅛	1 1/16	Apr. '23, Q	0.15
Vipond Cons.	Toronto	*50	*45	*46		
Wright-Hargreaves	Toronto	3.15	3.15	3.15	Apr. '23,	0.02½
Yukon Gold	N. Y. Curb	1⅛	1¼	1⅛	June '18,	0.02½
GOLD AND SILVER						
Boston-Mont. Corp.	N. Y. Curb	*19	*16	*19		
Con. Cortez	N. Y. Curb	*67	*65	*67		
Cons. Virginia	San Francisco	12⅛	10⅛	10⅛		
Continental Mines	N. Y. Curb	5⅛	5	5⅛		
Dolores Esperanza	N. Y. Curb	1⅜	1¼	1¼	Apr. '23	0.05
Jib Consol.	N. Y. Curb			*85		
Tonopah Belmont	N. Y. Curb	*80	*78	*78	Apr. '23, Q	0.05
Tonopah Divide	N. Y. Curb	*54	*51	*51	May 23	0.10
Tonopah Extension	N. Y. Curb	1⅞	1⅛	1⅛	Jan. '23, Q,X	0.10
Tonopah Mining	N. Y. Curb	1⅛	1⅛	1⅛	Apr. '23, Q	0.07½
Unity Gold	N. Y. Curb	4¼	3⅜	3⅜		
West End Consol.	N. Y. Curb	*95	*92	*95	Mar. '23, Q	0.05
SILVER-LEAD						
Bingham Mines	Boston	†*17	†*16	*16½	Sept. 19, Q	0.25
Cardiff M. & M.	Salt Lake	*58	*49	*50	Dec. '20,	0.15
Chief Consol.	Boston Curb	4¼	4	4¼	May '23, Q	0.10
Columbus Rexall	Salt Lake	*64	*54	*55	Aug. '22,	0.03
Consol. M. & S.	Montreal	27⅛	25½	27½	Oct. '20, Q	0.62½
Erupcion	Boston Curb	2⅛	2	2⅛	Apr. '23, Q	C.125
Federal M. & S.	New York	7⅛	7	7⅛	Jan. '09,	1.50
Federal M. & S. pfd.	New York	38⅛	37⅛	38⅛	Mar '23, Q	1.75
Florence Silver	Spokane	*38	*38	*38	Apr. '19, Q,X	0.01½
Hecla Mining	N. Y. Curb	8	7⅛	7⅞	June '23,	0.50
Iron Blossom Con.	N. Y. Curb	*27	*25	*25	Apr. '22, Q	0.02½
Marsh Mines	N. Y. Curb	*13	*11	*11	June '21, I	0.02
Park City	Salt Lake			3.15	Apr. '23,	0.12½
Park Utah	N. Y. Curb			3½	Apr. '23	0.15
Prince Consol.	Salt Lake	*4	*3	*3	Nov. '17,	0.02½
Silversmith	Spokane	*40	*38½	*39½	Apr. 23,	0.01
Simon Silver Lead	N. Y. Curb	*28	*28	*28		
Snowstorm Silver-L.	N. Y. Curb	*95	*95	*95		
Tamarack-Custer	Spokane	1.25	1.25	1.25	Jan. '21, K	0.04
Tintic Standard	Salt Lake	3.175	3.15	3.175	Dec. '22, Q,X	0.10
Utah-Apex	Boston	3⅛	3¼	3⅛	June '23, Q,X	0.50
IRON						
Bethlehem Steel	New York	51⅛	48½	50⅛	Apr. '23, Q	1.25
Char. Iron	Detroit			1		
Char. Iron, pfd.	Detroit			2⅛		
Colorado Fuel & Iron	New York	30⅜	27⅛	28⅜	May '23, Q	2.00
Col. Fuel & Iron pfd.	New York			102	Feb. '23, Q	2.00
Gt. North'n Iron Ore	New York	28⅛	27½	28½	Apr. '23	1.00
Inland Steel	N. Y. Curb			46½	June '23 Q	0.62½
Mesabi Iron	N. Y. Curb	7½	7½	7½		
Replogle Steel	New York	17¾	12½	16		
Republic I. & S.	New York	49½	45	47½	May '23	1.50
Republic I. S. pfd.	New York	88⅛	86	88⅛	Apr. '23	1.75
Sloss-Sheffield S. & I.	New York	47½	45	47½	Feb. '21	1.50
Sloss-Shef. S.&I. pfd.	New York	80	79	80	Apr. '23	1.75
U. S. Steel	New York	94⅜	90½	93⅜	Mar. '23, Q	1.25
U. S. Steel pfd.	New York	119½	118⅛	118½	May '23	1.75
Virginia I. C. & C.	New York	†59	†55	55	Jan. '22	1.50
Virginia I.C.&C.pfd.	New York		†77½	80½	Jan '23	2.50
VANADIUM						
Vanadium Corp.	New York	31½	28½	31⅜	Jan. '21, Q	1.00
ASBESTOS						
Asbestos Corp.	Montreal	56	52½	52½	Apr. '23 Q	1.50
Asbestos Corp. pfd.	Montreal	78	78	78	Apr. '23 Q	1.75
SULPHUR						
Freeport Texas	New York	12⅛	11	12⅜	Nov. '19, Q	1.00
Texas Gulf	New York	59½	56½	59½	May '23, Q	1.50
PLATINUM						
So. Am. Gold & P.	N. Y. Curb	3⅛	3	3		
MINING, SMELTING AND REFINING						
Amer. Metal	New York	45⅜	43¼	44	June '23, Q	0.75
Amer. Metal pfd.	New York			114	June '23, Q	1.75
Amer. Sm. & Ref.	New York	61⅜	57½	59½	Mar. '21, Q	1.00
Amer. Sm.& Ref. pfd	New York	97	96½	96½	June '23 Q	1.75
U. S. Sm. R. & M.	New York	27½	22½	24	Jan. '21, Q	0.50
U.S. Sm.R.& M. pfd.	New York	†44½	†43	44	Apr. '23 Q	0.87½

*Cents per share. †Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra.

Toronto quotations courtesy Arthur E. Moysey; Spokane, Pohlman Investment Co; Salt Lake, Stock and Mining Exchange; Los Angeles, Chamber of Mines and Oil; Colorado Springs, Colorado Springs Stock Exchange.

NEW MACHINERY AND INVENTIONS

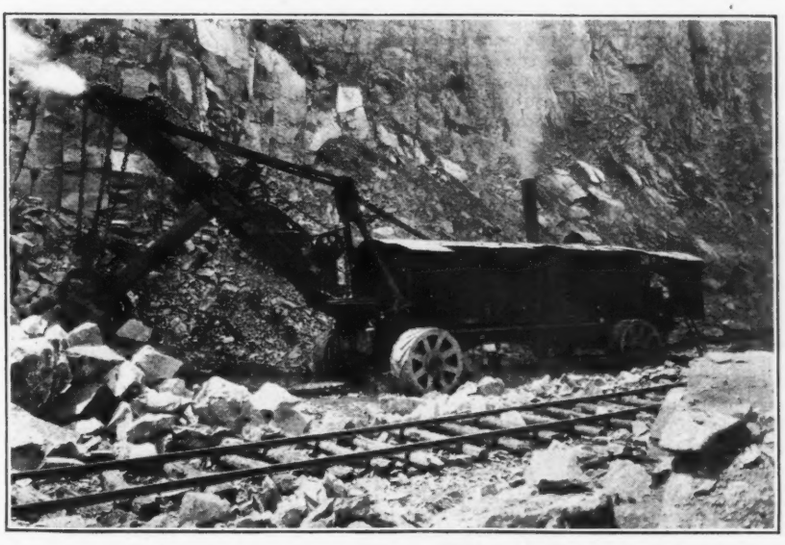
Traction Wheels for Railroad-Type Steam Shovels

The Osgood Company, Marion, Ohio, has recently placed on the market railroad-type steam shovels equipped with traction wheels. Giant traction wheels were designed that measure 6 ft. in diameter and have a face of 36 in. on the front or drive wheels and 30 in. on the rear wheels. The front wheels are used as drivers and power is delivered through a series of gears from the powerful hoisting engines on the shovel. Steering is accomplished by turning the rear wheels by means of a screw shaft and traveling nut. The nut, to which is attached the axle tongue, moves along the screw shaft, slewing the rear axle and wheels in the direction desired. The screw shaft is operated by a separate reversible steering engine mounted above deck alongside the boiler, out of the way yet readily accessible. Reversing the engine causes traveling nut to move in the opposite direction. The engine is controlled and steering accomplished by means of a single lever from the engineer's position in the forward end of the cab.

The advantages claimed for traction wheels over railroad trucks for large railroad-type steam shovels, briefly summarized, are: greater mobility of machine, elimination of pit crew, easier accessibility to face of excavation, elimination of tracks and reduction of side strains and racking to the machine in general. Traction wheels also have a decided advantage over any other type of mounting in that the traction wheels are much less complicated, simpler to operate and have a much lower upkeep cost.

A large stone company near Chicago has just installed an Osgood 73—3½-cu.yd. traction shovel for use in the quarry. The pit is about 80 ft. deep and is reached by a very steep incline. To get the new machine into the pit would ordinarily be quite a problem, but when equipped with traction wheels the problem was much simplified. With boom up and dipper and handle in place the shovel was backed down the steep declivity under its own power without difficulty.

Shortly after this shovel had been placed in operation a cut of loaded dump cars was derailed when some distance from the shovel and on the way to the incline hoist. The traction shovel was thrown into gear, run down to the cars, a chain hooked over the dipper teeth and around the cars. In a few minutes the train was rerailed and on its way to the hoist, while the shovel went back to the rock face ready for work. It would have been necessary to unload the cars to rerail them by hand, and then reload them. While this was being done the shovel and other cars would have been standing idle if the ready mobility of the shovel had not saved the day. The shovel has also been used about the quarry for handling boilers and other heavy machinery that would require the services of a locomotive crane.

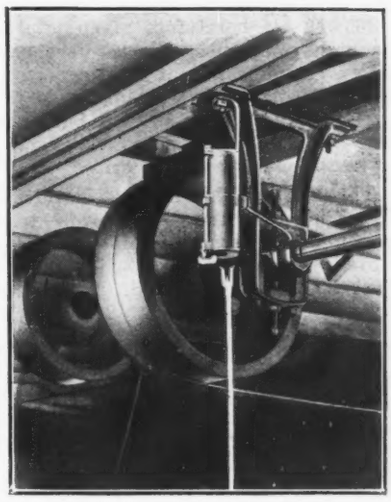


6-cu.yd. railroad-type steam shovel in a quarry in Pennsylvania

A Shaft Oiler Which Is Easy To Operate

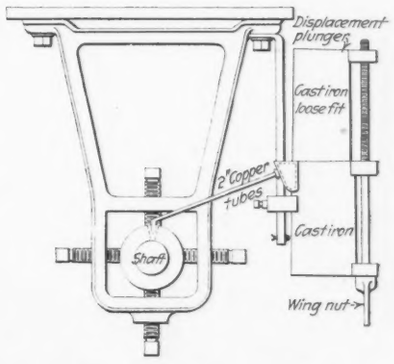
The fact that shafting is difficult to oil is one reason which keeps it from getting the attention which it needs. The device described here makes it possible to oil shafts with ease from a position on the floor by turning a wing nut with a stick. Besides avoiding accidents it saves time which would be spent in dragging a step ladder around and stopping to set it up every few minutes.

The device has two principal parts, a cylinder containing oil and a displacing plunger. An iron suspension rod holds the device in position at one side of a shaft hanger. The oil displacing plunger is mounted on an upright and operated by a traversing screw running in lugs which are cast with the two parts of the oiler. At the bottom of this screw a wing nut is provided, which may be engaged by a socket on the end of a pole sufficiently long so that the oiler may be manipulated from the floor.



Oiling device for line shafts

From the upper part of the oil container two tubes run to oil holes on either side of the bearing. One turn of the wing nut on the traversing screw by means of the pole forces sufficient oil into the shaft bearing. The container holds enough oil to last a year. This oiler is manufactured by the Ricker Manufacturing Co., 239 North Water St., Rochester, N. Y.



Sketch of oiling device

INDUSTRIAL NOTES

Recently the Western Machinery Co. acquired, by purchase, the real estate, buildings, machine tools, patterns, drawings, and other equipment of the Fulton Engine Works, of Los Angeles. The Fulton Engine Works has been the largest manufacturer of mining and power and contractors' hoisting equipment on the Pacific Coast for many years. By acquisition of this property the Western Machinery Co., manufacturers of gas and Diesel engines, will be enabled to increase its production

and also extend its lines of manufacture. Hoists heretofore manufactured by both companies will be developed into a complete line of hoisting equipment. Plans are now being made for the alteration of the present buildings and the addition of others, which will make the plant more modern.

The W. S. Tyler Co., of Cleveland, Ohio, manufacturers of woven wire screen and screening equipment, have moved their New York office to the Park-Lexington Building, 247 Park Avenue.

The Webster Manufacturing Co. of Chicago announces the appointment of Robert T. Pierce as manager of its New York sales office at 90 West St. He succeeds the late Glen N. Porter, who died March 31 of this year.

D. Earl Dunn, until recently in charge of mining equipment in the sales and promotion department of the Ingersoll-Rand Co. of New York and well known as former secretary of the Technical Publicity Association of New York, has recently been appointed assistant manager of the California Equipment & Supply Co., 205-207 North Los Angeles St., Los Angeles, Calif.

Realizing that the marking of gears means the elimination of a great deal of trouble, the William Ganschow Co., of Chicago, Ill., pioneers in the cut gear field, have adopted the practice of marking on each gear not only their trade mark, but also a production number upon which the gear was manufacctured and the date of its manufacture.

The Connecticut Blower Corporation, Hartford, Conn., has been incorporated under the laws of Delaware with capital of $250,000. M. E. Keeney is president, C. H. Keeney, treasurer, and C. E. Keeney, secretary. It has taken over the International Blower Co. and the Hartford Sheet Metal Works. The products manufactured and installed are of a large variety, such as blowers and exhaust fans, blower systems of all kinds, dust collecting systems, exhaust systems, and ventilating systems. The plant of the International Blower Co. will be utilized until fall at which time a considerably larger plant will be occupied.

The Roller-Smith Co., 233 Broadway, New York, announces the appointment of H. D. Baker, 525 Woodward Ave., Detroit, Mich., as its representative in Michigan. Mr. Baker will handle the Roller-Smith Company's lines of instruments, circuit breakers and radio apparatus in that territory.

The American Welding Society has just issued an outline of a course for the training of oxy-acetylene welders. This report was prepared by a committee and combines the experience of experts of the Federal Board of Vocational Education, the American Welding Society and the National Research Council. For the information of the person who is selecting candidates, the text includes a discussion of the qualifications which the candidates for training should possess. For the information of the instructor, the text includes the fundamentals in gas welding, together with a detailed [illegible]ement of content, classified under typ[illegible]l welding jobs arranged in the order of difficulty. Copies may be secured from the American Welding Society, 29 West 39th St., New York City.

The Link-Belt Co., of Chicago, has adopted the policy of establishing annual "Sales Schools" for the new members of its sales force. The most recent of these classes was held at the Link-Belt Indianapolis factory, June 4, 5 and 6. The salesmen, eighteen in number, came from the Detroit, Pittsburgh, Toronto, Chicago, Boston, New York, Kansas City, St. Louis, and Dallas offices. This school permits the men to see and inspect the various malleable and steel chain manufactories and to meet the officers and department heads of the plants. The interchange of ideas among the men themselves, coming as they do from such widely separated points, also makes for better feeling, fraternity, and a dissemination of valuable sales information.

The Elk Manufacturing Co., of New York, has been taken over by the Elk Machine Tool Corporation with increased capitalization. The new company will continue to manufacture and sell all the precision tools formerly made by the Elk Manufacturing Co., under the Elkin patents. It will be situated July 15 in its new plant at 243 West 17th St., New York, which is being equipped for quantity production of high-grade precision tools, and will have direct representatives and branches in about twenty-five cities of the United States.

At the meeting held in Pittsburgh, Pa., on June 16 by the five companies forming the Electric Steel Founders' Research Group the following standard trade practices were adopted:

1. Suitable pattern equipment for economical molding shall be furnished by customer.
2. The foundry will not be responsible for corrections of pattern equipment to blueprint, except when such equipment is made for the customer under the supervision of the foundry.
3. Repairs on pattern equipment shall be paid for by the customer, except when occasioned by carelessness on the part of the foundry.
4. Patterns must have distinctive colors to identify separately the coreprints, machined surfaces, and rough casting.
5. All patterns, coreboxes, and loose pieces thereof must be properly numbered for identification.
6. All transportation charges on pattern equipment to and from foundry, shall be paid by the customer.
7. The foundry will not carry insurance on customers' pattern equipment.
8. Free replacement will be made of defective castings, if reported and returned to foundry within a reasonable time.
9. The foundry will not be responsible for any expense on defective castings incurred by the customer.
10. The customer will be charged with the cost of molds and cores discarded by the foundry, due to change in patterns or coreboxes.

The increased volume of steel business is reflected in the construction program of the Carnegie Steel Co., at their Munhall, Pa., plant. Eight new 834-hp. Stirling boilers and eight New Model Westinghouse underfeed stokers will supply steam for steel production. The gradual increase in the steel business is reflected in the fact that this contract is the twelfth repeat order of this plant for Westinghouse stokers. The new stoking equipment includes steam power refuse dumping mechanisms, non-clinkering extension sidewall tuyeres and automatic secondary ram fuel bed control adjusting mechanisms. Engberg vertical steam engines will drive forced draft fans. This plant uses Pittsburgh coal.

TRADE CATALOGS

The Westinghouse Supply Catalog, which is generally regarded as an encyclopedia of things electrical, is now being distributed. This issue for 1923-24 replaces and supersedes all catalogs issued heretofore on electrical supplies by the company. In appearance it is quite similar to its predecessor. Close observation, however, shows that the new issue presents a wider variety of apparatus than any catalog heretofore issued by Westinghouse. All sections have been completely revised and some rearranged, which greatly facilitates the ordering of equipment.

The catalog contains 1,300 pages and is indexed according to subjects and to sections, and also has a style number and a thumb index. In addition, a new feature—a classified index—has been added to the introductory section under the title "How this catalog serves." Here is listed apparatus of particular interest to central stations, electric railways, industrial plants, mines, contractor-dealers, and architects.

The opening is announced of a new Westinghouse plant at Homewood, Pa., which will be devoted exclusively to the manufacture of repairs and renewal parts for Westinghouse apparatus in service but of design no longer strictly standard. A complete list of all Westinghouse sales office, agent jobbers' warehouses, and service repair shops is also given, together with several illustrations of new combination sales, service and warehouse buildings either recently built or now in course of construction.

Refractories—Fire brick, fire-brick mortar, furnace linings and other refractory products made by Lacledе-Christy, of St. Louis, Mo., are described in an eight-page pamphlet just issued.

Volume 115 June 30, 1923 *Number* 26

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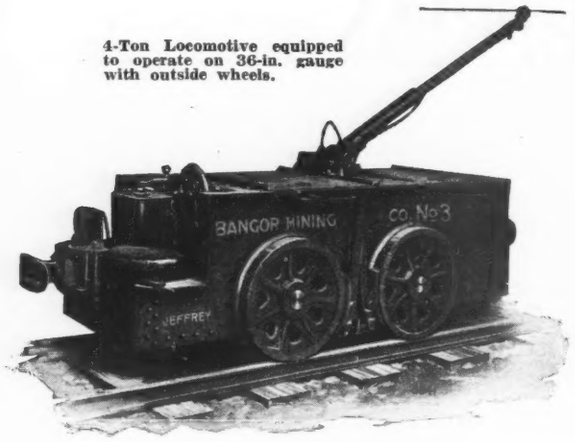
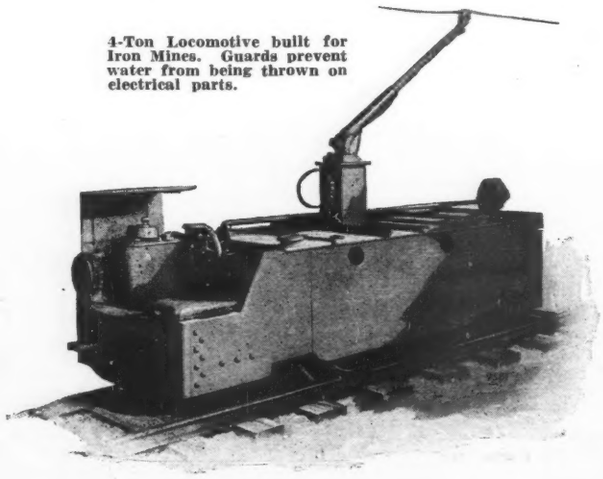


4-Ton Locomotive equipped to operate on 36-in. gauge with outside wheels.

4-Ton Locomotive equipped to operate on 24-in. gauge with inside wheels.



4-Ton Locomotive built for Iron Mines. Guards prevent water from being thrown on electrical parts.

Designed and Built Especially for Iron Mines

THE two upper illustrations show Jeffrey 4-ton narrow gauge locomotive. In one case the wheels are outside of the frame, being 36-in. gauge, and in the other case are inside the frame, being 24-in. gauge. All that is necessary is to change the wheels and axles.

In locomotives of the type shown in lower illustration all electrical parts are protected from water by guards provided over wheels and over controller.

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Model 300 Turbro Waughoist

General Specifications

Length, inches	33¾	Vertical lifting speed at maximum load, ft. per min.	118
Width, inches	19⅜	¼-inch rope capacity, feet, both drums	775
Height, inches	18	Air inlet, size, inches	¾
Drums, length, inches	4¾	Weight, pounds, boxed for shipment	593
Drums, diameter, inches	6¼	Hose recommended	1-inch
Horsepower, average for all loads	10		
Vertical lifting capacity, lbs., at 50 lbs. air	2200		

WITH Model 300 Turbro Waughoist on the job, victory in your underground mining battles is easily had. Further details concerning this remarkable new machine are contained in the 300 bulletin. Ask the nearest Waugh branch office for your copy today.

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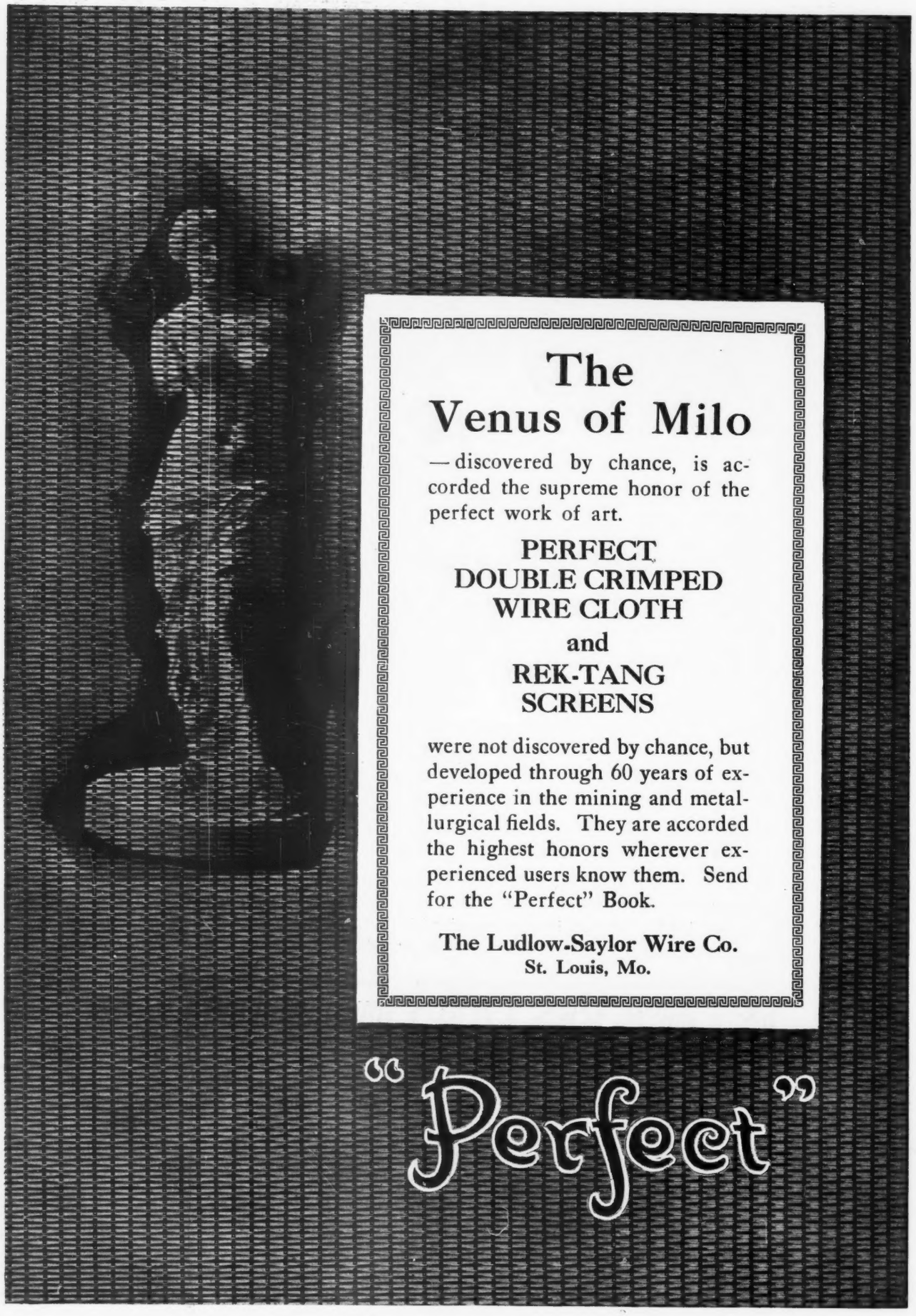
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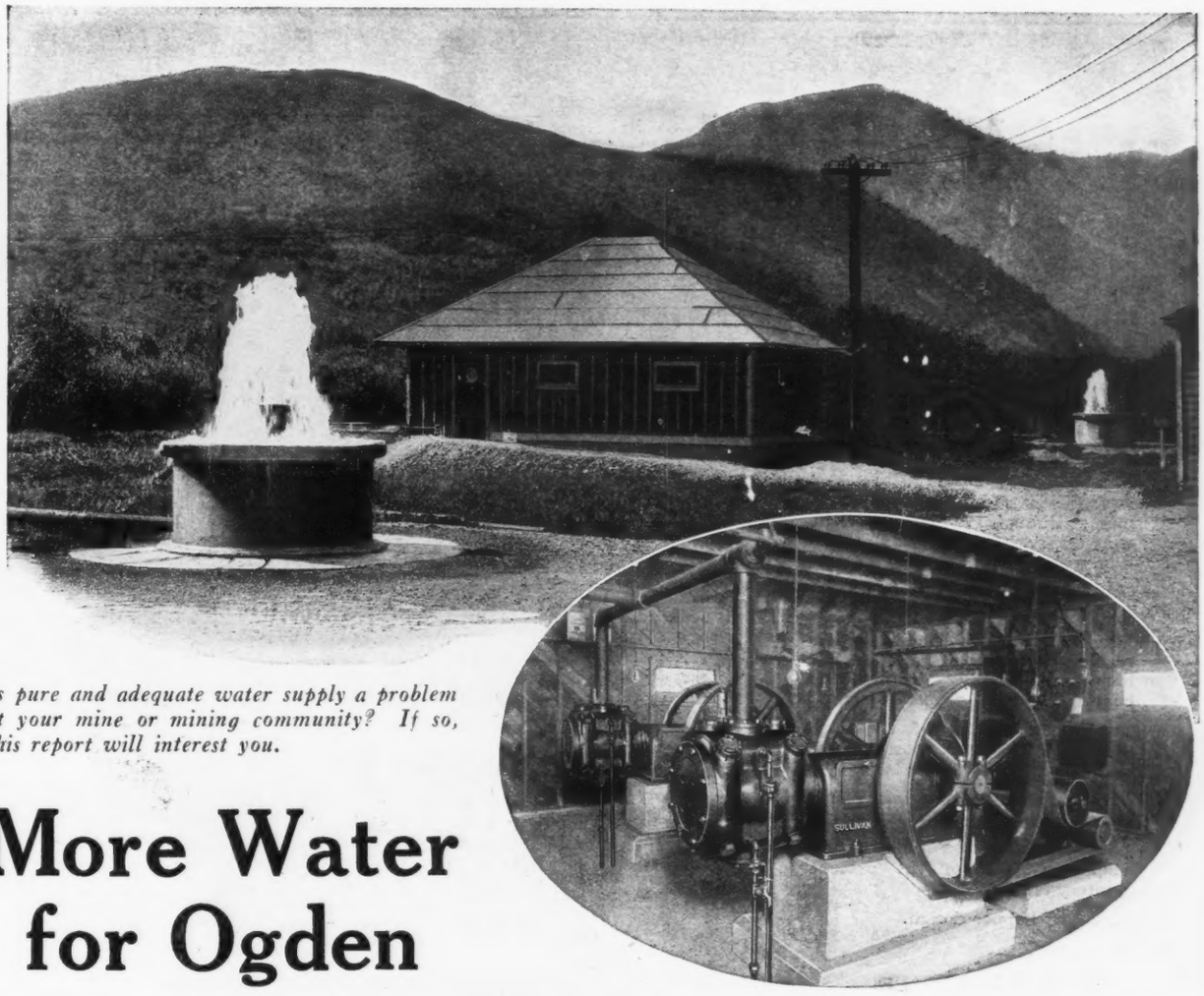

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Ask for Air Lift Bulletin 271G

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3—Greater discharge opening and stronger construction.

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5—The lubrication is of the simplest and the most positive design.

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7—The reduction of installation height of 16% of the present gyratory crushers.

8—Improved hopper design.

9—Dust proof.

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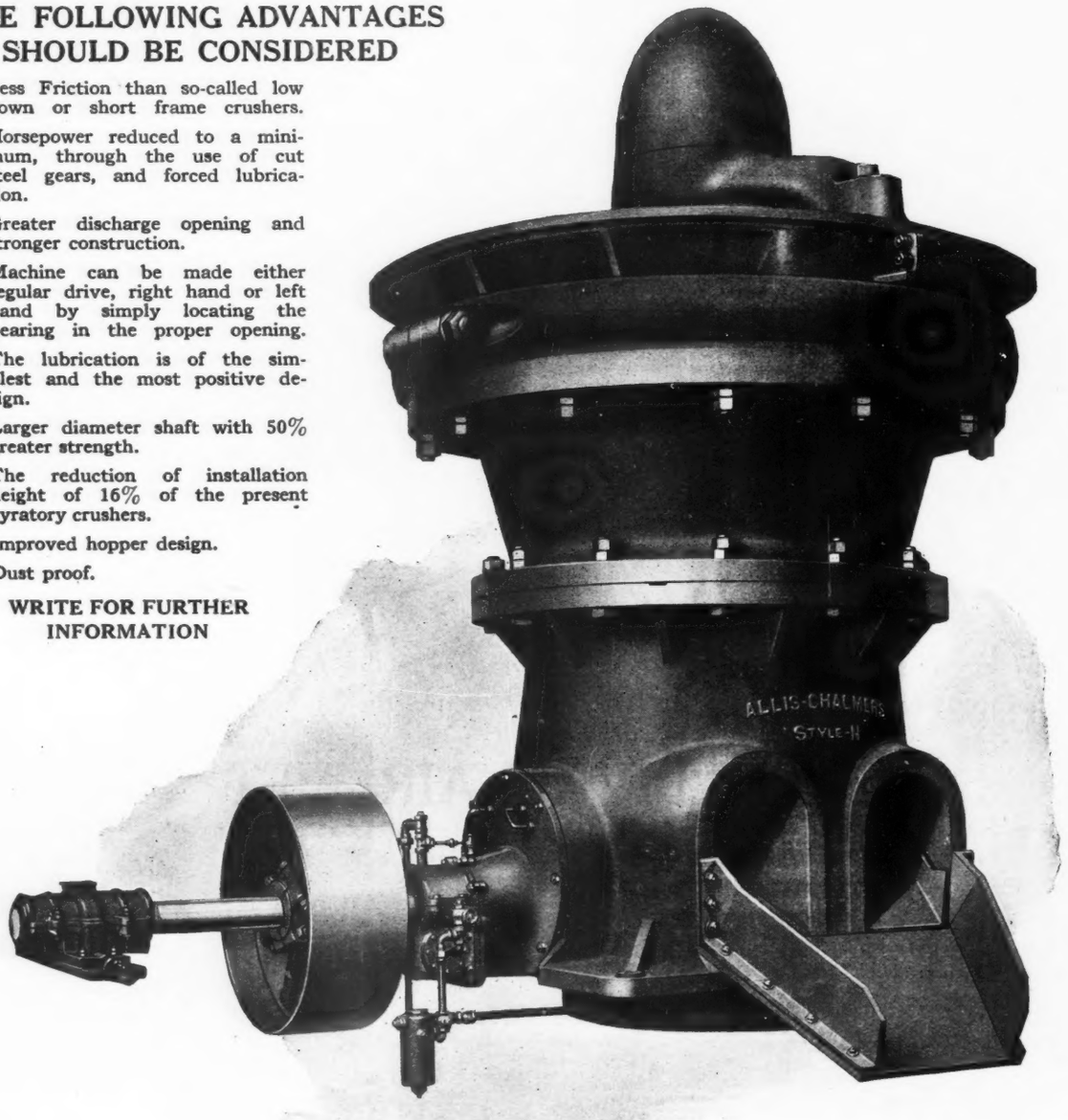

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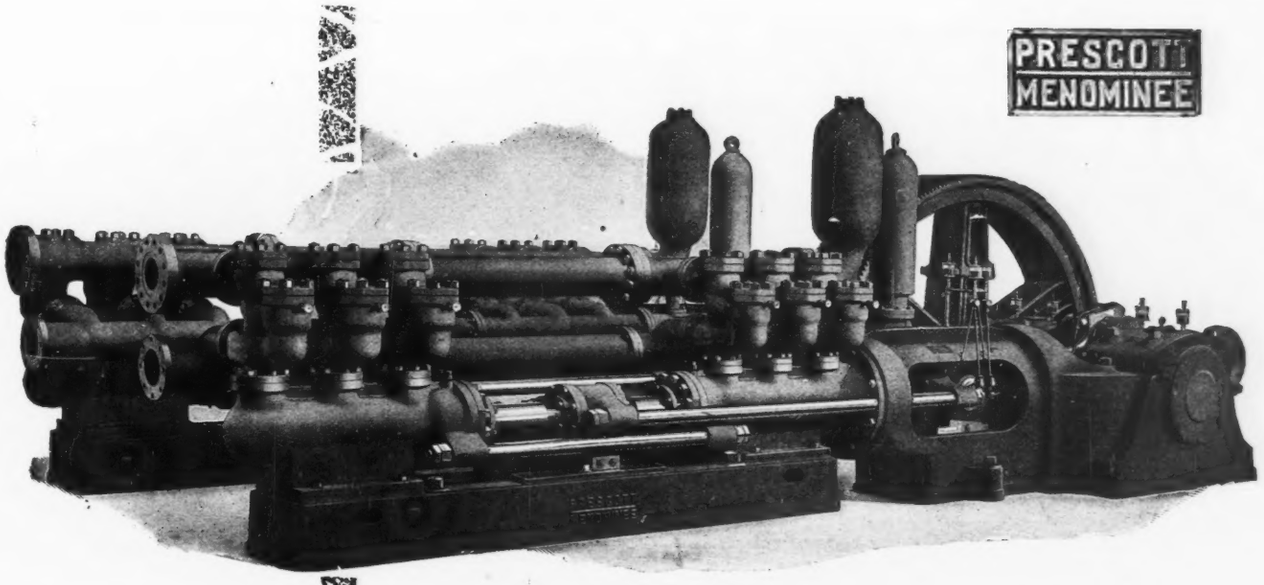

They demonstrate the economy of single-lift pumping

Prescott-Menominee Duplex mine pumps are *built* for the heavy duty of single-lift pumping, for even the deepest mines. They demonstrate that the single-lift principle in draining very deep mines is not only practical, but also by far the most efficient and most *economical* method.

One operater recently reported a saving of $16,800.00 per year on labor alone as a result of installing Prescott-Menominee Pumps, with single-lift pumping. Instead of four pumping crews, now only one is required. In addition, there has also been a tremendous saving in power, cost of pumping equipment, etc.

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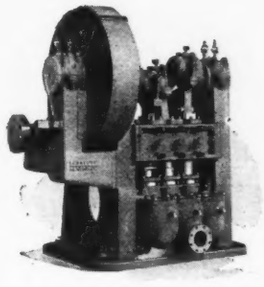
Put *your* pumping problem up to the Prescott Company engineers. The results of years of experience and contact with mine drainage problems is at the service of any mine man.



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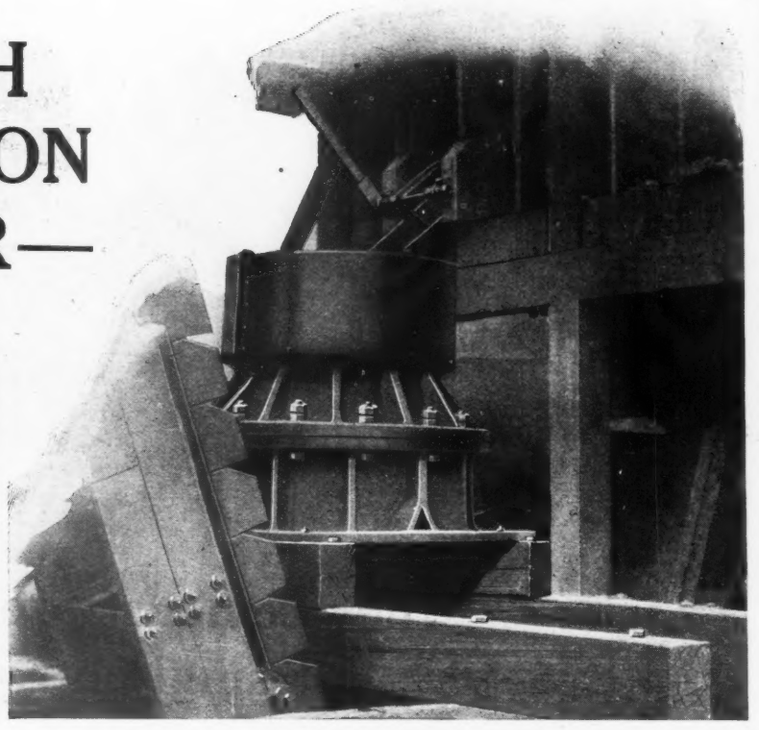
TELSMITH REDUCTION CRUSHER—

A *NO-WORRY* RE-CRUSHER



The Telsmith Reduction Crusher needs no coddling. Put a steel hopper over it, as shown in the picture. Open up the bin gate; fill up the hopper and *keep it full.* The Telsmith Re-crusher takes a gravity flow of coarse rock. No hand or mechanical feeding is necessary. The machine does its best work when choke-fed. Just keep the bolts tight; change the oil once a week and read the oil temperature every hour. With a clean feed of economical size, the Telsmith Reduction Crusher requires no other attention.

No electro-magnetic protection is necessary. The machine is a brute for strength—about 80 per cent steel. Very little fly-wheel effect is developed. The main parts—frame, crown and central shaft are guaranteed against breakage by drill-steel, hammerheads, etc. Tramp iron may be released by loosening up the main frame bolts.

Have you ever operated a re-crusher that you could *bank on* —one that you could forget about? It's a pleasant sensation, which only Telsmith can inspire. Try it! Glad to send you Bulletin No. 2F1 (Telsmith Reduction Crusher) or Catalog No. 168 (Telsmith Primary Breaker).

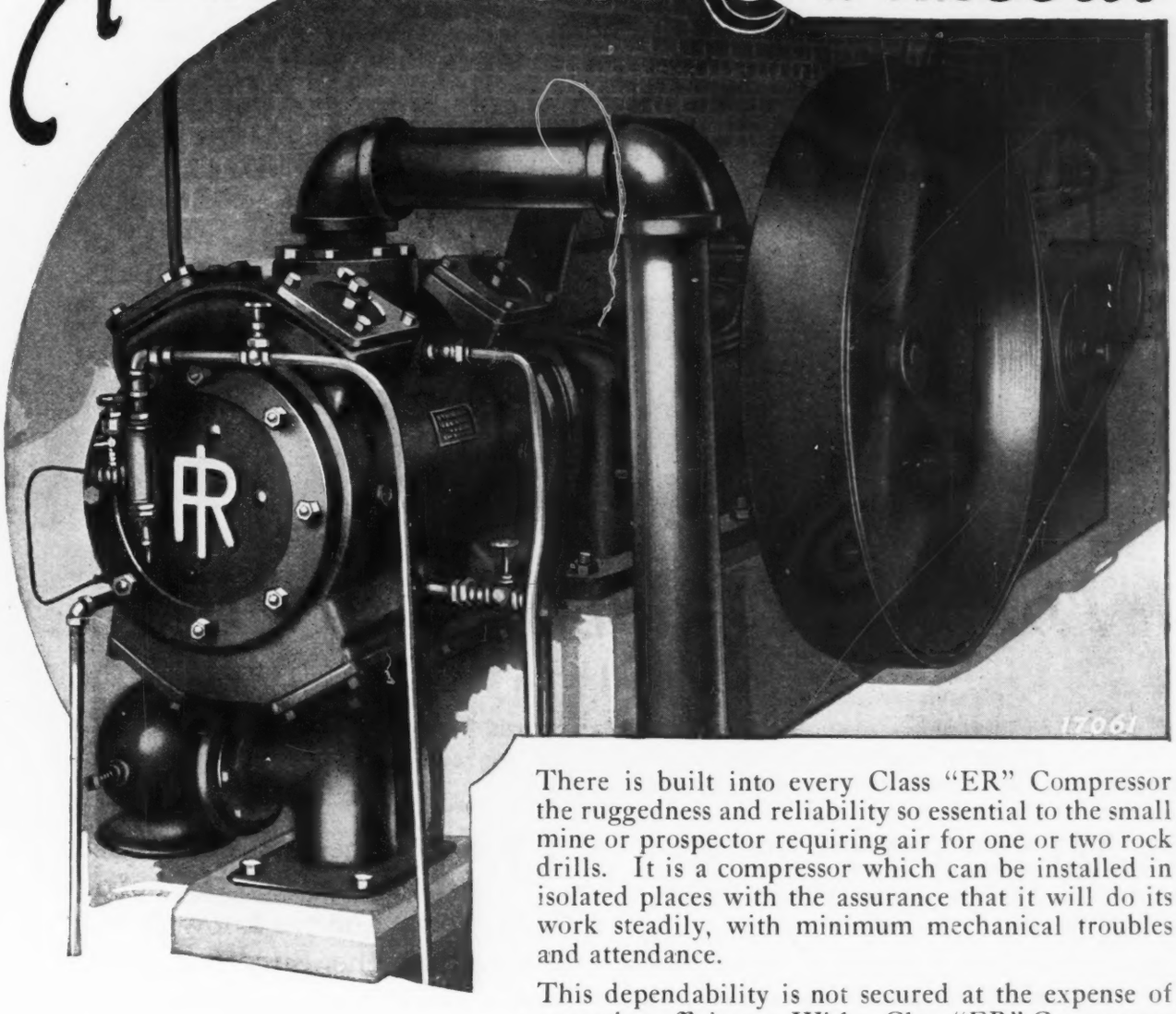
SMITH ENGINEERING WORKS 3195 LOCUST STREET, MILWAUKEE, WIS.

Canadian Representatives: Canadian Ingersoll-Rand Co., Montreal, P Q.

Old Colony Bldg., Chicago, Ill. | 50 Church St., New York City | 806 Otis Bldg., Philadelphia Pa. | 110 W. Park Way, N. S. Pittsburgh, Pa. | G. R. Mueller Co., Birmingham, Ala.

2540 University Ave., St. Paul, Minn. | 523 Boston Bldg., Denver, Colo. | Salt Lake Hardware Co., Salt Lake City, Utah | 625 Market St., San Francisco, Calif. | 617 Hollingsworth Bldg., Los Angeles, Calif.

A DEPENDABLE COMPRESSOR



There is built into every Class "ER" Compressor the ruggedness and reliability so essential to the small mine or prospector requiring air for one or two rock drills. It is a compressor which can be installed in isolated places with the assurance that it will do its work steadily, with minimum mechanical troubles and attendance.

This dependability is not secured at the expense of operating efficiency. With a Class "ER" Compressor your air power is furnished to the drills at the *lowest cost per cubic foot actually delivered.*

Among the features of Class "ER" construction are: Ingersoll-Rand Plate Valves, Removable Bearings, Automatic Regulation, Enclosed Construction, and Automatic Lubrication. These compressors can be furnished for either long or short belt drive.

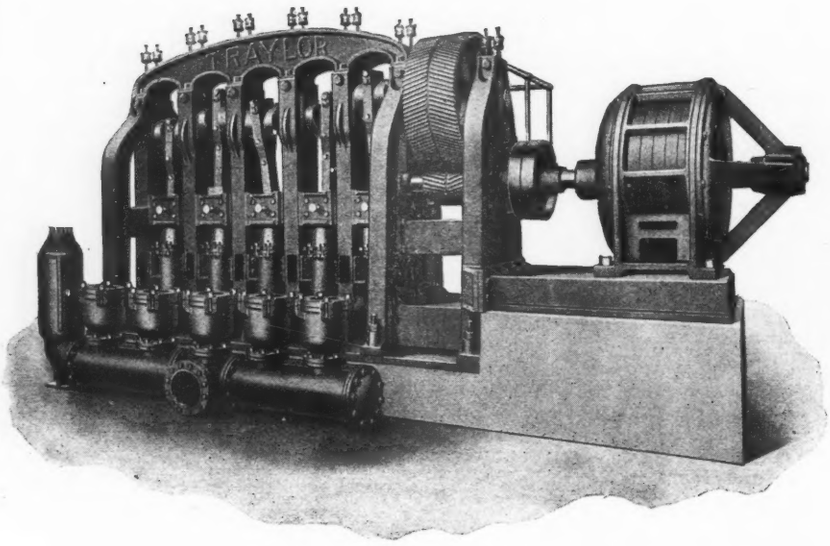
Bulletin No. 3430

INGERSOLL-RAND COMPANY
11 Broadway, New York
Offices in all principal domestic and foreign cities
For Canada refer Canadian Ingersoll-Rand Co. Limited
260 St. James St., Montreal

726-C

Ingersoll-Rand

ENDURINGLY EFFICIENT



For severe duty specify the—

SuperPump

WE designed this pump to meet the hypercritical demands of mining men, knowing full well that if it would please *them* it could not fail to pass any other test.

UNDER these circumstances we could not stop short of our best efforts, and we know so positively that the Superpump will make good that we guarantee it unreservedly in every particular.

TRIPLEX—QUINTUPLEX—VERTICAL—HORIZONTAL

See Bulletin 101P

TRAYLOR
ENGINEERING AND MFG. CO.
ALLENTOWN, PA.

NEW YORK 30 Church St. | PITTSBURGH 1203 Fulton Bldg. | CHICAGO 1414 Fisher Bldg. | LOS ANGELES I. W. Hellman Bldg. | SEATTLE 815 Alaska Bldg. | SALT LAKE CITY 101 W. 2nd South St. | LAREDO, TEXAS 1806 Farragut Ave.
TIMMINS, ONTARIO, CANADA, Moore Block

Export Department, 104 Pearl Street, New York City—Cable Address "Forsaltra"
International Machy. Co., Santiago, Chile | *W. R. Grace & Co., Lima, Peru* | *International Machy. Co., Rio de Janeiro, Brazil*

After all—what users say counts most!

A Texas Transportation and Shipping Company writes—

"This machine (N SO2 C-P Oil Engine Driven Air Compressor) has discharged air at as high a pressure as 115 lbs., which indubitably substantiates your claims and establishes the fact that your rating is not high enough"

A California Gold Mining Company states—

"This compressor (N-SO2 C-P Oil Engine Driven Air Compressor) has proven highly efficient. The fuel consumption of 27 gravity oil, and maintenance costs have been very low. Regulating adjustments are very simple, and require only ordinary attention."

An Arizona Copper Company reports—

"For economy, efficiency and maintenance, your 300 ft. Semi-Diesel Direct Connected Air Compressor, which we have used for over one year, is all that could be desired."

Another Mining Company advises—

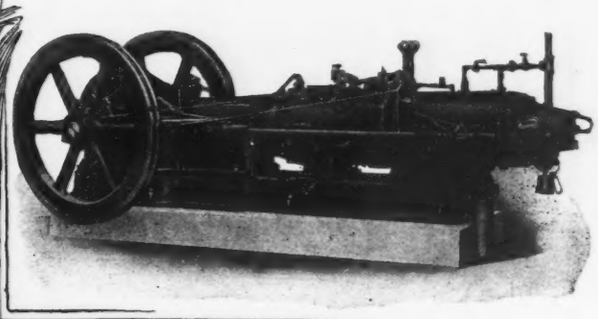
"During the 14 months this machine (C-P Oil Engine Driven Air Compressor) has been in continuous operation, it has given entire satisfaction. It is economical with fuel and oil, is efficient, and the cost of maintenance has been nil."

The type of compressor referred to in the extracts of user testimonials is illustrated below. (Yet it is but one of over 500 types and sizes embodied in the entire C-P line.)

It supplies a complete air compressing plant in one unit. Power and air cylinders are direct connected.

The unit operates dependably and economically on low cost fuel oils. Adaptable in batteries to large air power requirements.

Stationary, skid and truck-mounted types are built in several sizes. Ask for Bulletin 607



1986

BUY a Chicago Pneumatic Air Compressor like you hire men—on past performance.

Ascertain where C-P Compressors, operating under conditions similar to yours, are installed. Find out how long and how well they have operated.

Ask about Simplates—the original concentric-disc independent plate valve.

Question users about other C-P features such as automatic regulation, lubrication and liberal bearing surfaces.

And from this information sum up what the installation of C-P Compressors in your plant means in operating economy and serviceability.

Carefully compare this data with what C-P Engineers have told you about C-P features. Check such data with your ideals of what a compressor should be and do.

Then you'll find a compressor that meets the most exacting specifications.

Let us aid you in following these suggestions by supplying the names of C-P users and instructive bulletin.

Chicago Pneumatic Tool Company

Chicago Pneumatic Building · 6 East 44th Street · New York

*Sales and *Service Branches all over the World*

*Birmingham *Boston *Buffalo *Chicago *Cincinnati *Cleveland *Detroit El Paso Erie Franklin Houston Joplin *Los Angeles *Minneapolis *New Orleans *New York *Philadelphia *Pittsburgh *Portland Richmond Salt Lake City *San Francisco *Seattle *St. Louis Barcelona *Berlin Bombay Brussels Buenos Aires Cadiz Christiania *Fraserburgh Havana Honolulu Johannesburg Lisbon *London Madrid Milan *Montreal Osaka Paris Seoul Tokyo Toronto Vancouver Winnipeg

C-103

BOYER PNEUMATIC HAMMERS · · LITTLE GIANT PNEUMATIC AND ELECTRIC TOOLS
CHICAGO PNEUMATIC AIR COMPRESSORS · · VACUUM PUMPS · · PNEUMATIC HOISTS
GIANT OIL AND GAS ENGINES — ROCK DRILLS · · COAL DRILLS

CHICAGO PNEUMATIC

The Compressor with the Simplate Valve

Pays for itself with the money it saves

① *Lower Cost Per Ton*
② *Lower Construction Cost*
③ *Lower Maintenance Cost*
④ *Lower Labor Cost*

SYMONS
Vertical Disc Crushers

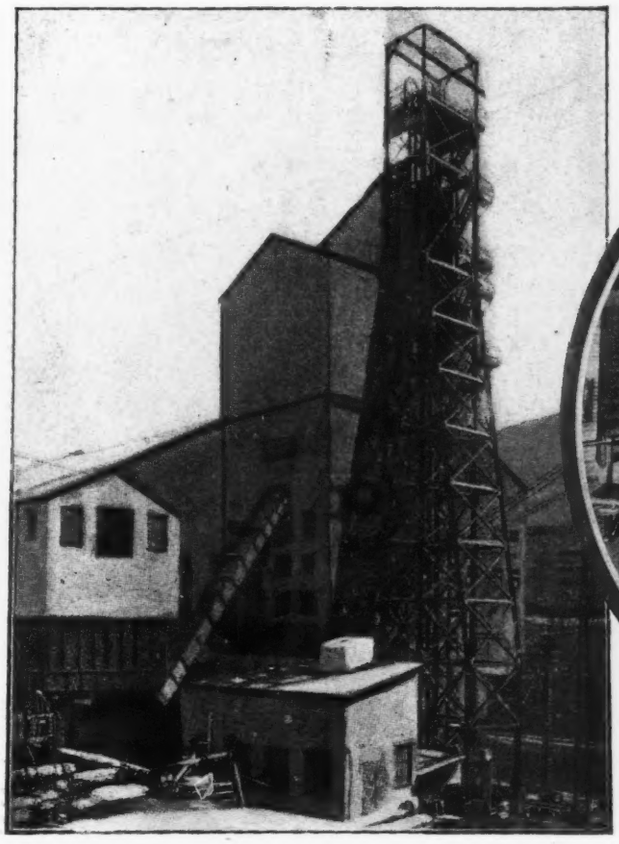
FIRST cost is irrelevant in equipment that is to endure. It is the cost of operation and maintenance over a period of years, that determines true cost.

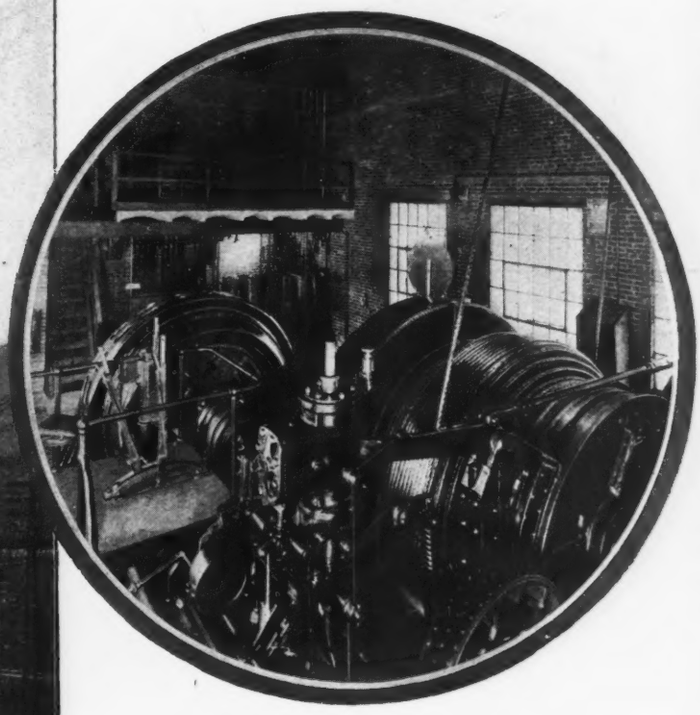
SYMONS DISC CRUSHERS

pay a dividend in greater profit from the time of installation. We will gladly explain in detail.

Manufactured and sold by

CHALMERS & WILLIAMS, INC.
1400 ARNOLD STREET, CHICAGO HEIGHTS, ILL. *Representatives at Leading Trade Centers*





Exceeding expectations by 500 tons per hour!

The original specifications at No. 6 Shaft of the Cambria Steel Company's Mine at Rosedale called for equipment to handle 750 tons of coal per hour. The delay allowed for dumping and loading was 10 to 12 seconds.

This capacity has now been increased to 1,250 tons per hour.

It is a 1000 h.p. Vulcan Hoist with a double cylindro-conical drum; completely equipped with safety devices. The hoisting is done in balance; total travel of rope 350 feet.

Full particulars on this and other electric and steam hoist installations in many parts of the country supplied upon request

Other Vulcan Equipment

- Steam Locomotives
- Gasoline Locomotives
- Rotary Kilns, Dryers, Coolers and Roasters
- Mine Ventilating Fans
- Cages and Skips
- Sheave Wheels
- Corliss Engines
- Coal Crushers and Rolls
- Gray Iron Castings
- Open Hearth Steel Castings
- Gears, Moulded and Cut Teeth
- Special Machinery

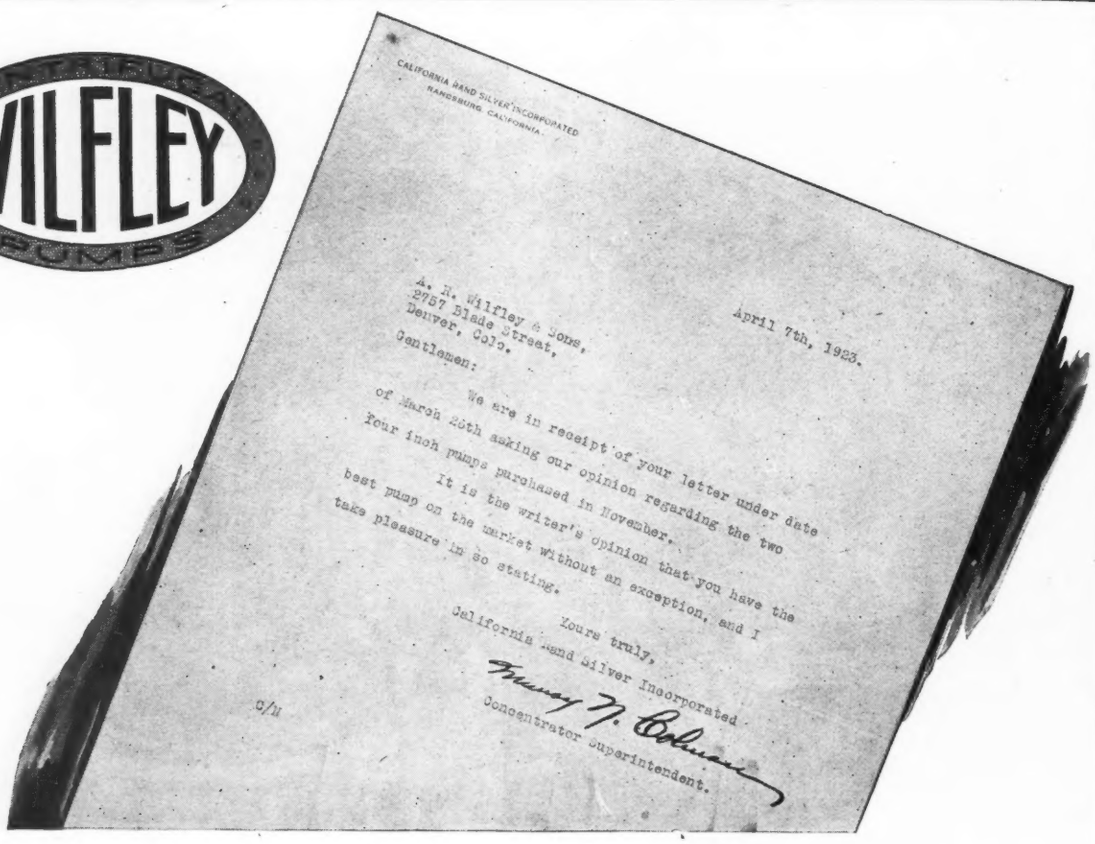
VULCAN IRON WORKS

Established 1849

1733 Main Street, Wilkes-Barre, Pa.

VULCAN OF WILKES-BARRE HOISTS

WILFLEY
PUMPS


CALIFORNIA SAND SILVER INCORPORATED
RANDSBURG, CALIFORNIA

April 7th, 1923.

A. R. Wilfley & Sons,
2757 Blake Street,
Denver, Colo.

Gentlemen:

We are in receipt of your letter under date of March 26th asking our opinion regarding the two four inch pumps purchased in November.

It is the writer's opinion that you have the best pump on the market without an exception, and I take pleasure in so stating.

Yours truly,
California Sand Silver Incorporated
Concentrator Superintendent.

C/M

DISTINCTIVE FEATURES

1. High efficiency and capacity constantly maintained.
2. Wearing parts very heavy, requiring minimum of changes.
3. Wearing parts easily changed in less than ten minutes.
4. Wearing parts made of our special iron.
5. Operates successfully against unusually high heads.
6. No stuffing box troubles.
7. Requires no clear high pressure water.
8. Can run idle without damage.
9. Shaft not subject to wear.
10. No bearing troubles.
11. Delivers a continuous, uniform stream.
12. No excessive peak loads.
13. Built for heavy duty.
14. Requires practically no attention.
15. Reduces operating costs.

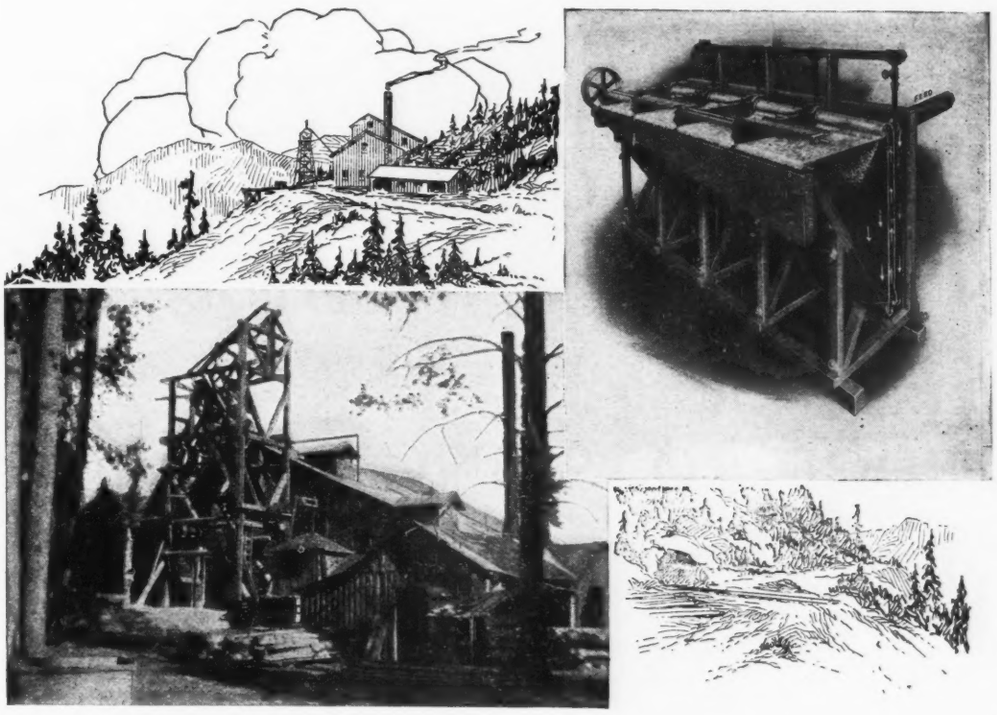
THE above letter from the concentrator superintendent of this bonanza property in California echoes the sentiment of all Wilfley pump users.

The Wilfley pump has been and is a success wherever it has been installed—that's why a large proportion of our business is repeat order business.

We can't build all the centrifugal sand pumps in the world but we can and do build the best of them. Let us send you a complete description.

A. R. WILFLEY & SONS
2763 Blake Street, Denver, Colo., U. S. A.

WILFLEY CENTRIFUGAL SAND PUMP
PATENTED



How the Banner Floats

AT THE Banner Mines Company's Mill, Philipsburg, Montana, they had a selective flotation problem in which it was necessary to float out the gold-bearing sulphides and drop the iron sulphides. To do this, a light froth having an affinity for that portion of the ores carrying the values was required.

THEY found that this interesting problem could only be solved efficiently with a Brown Flotation Machine. Accordingly, one four-cell Brown was installed since which time it has been treating 40 tons of gold-bearing pyrite daily, with the following result:

Crude Ore 60% FeS_2	
Ratio of Concentration	6.5 to 1
Recovery of Values	90% to 94%
Mesh Grind	80 mesh
Dilution of Feed	5 to 1

THE explanation of Brown success in selective flotation is simple—lots of air, a brittle froth, and the froth put on top of the pulp where it belongs. Send us a sample of your ore today and we'll be glad to demonstrate Brown selective flotation for you and at the same time point the way to larger profits in your mill.

THE STEARNS-ROGER MFG. CO.
ENGINEERS MANUFACTURERS CONTRACTORS
DENVER, COLO.
MINING AND MILLING MACHINERY AND PLANTS

What Combination Do You Want?

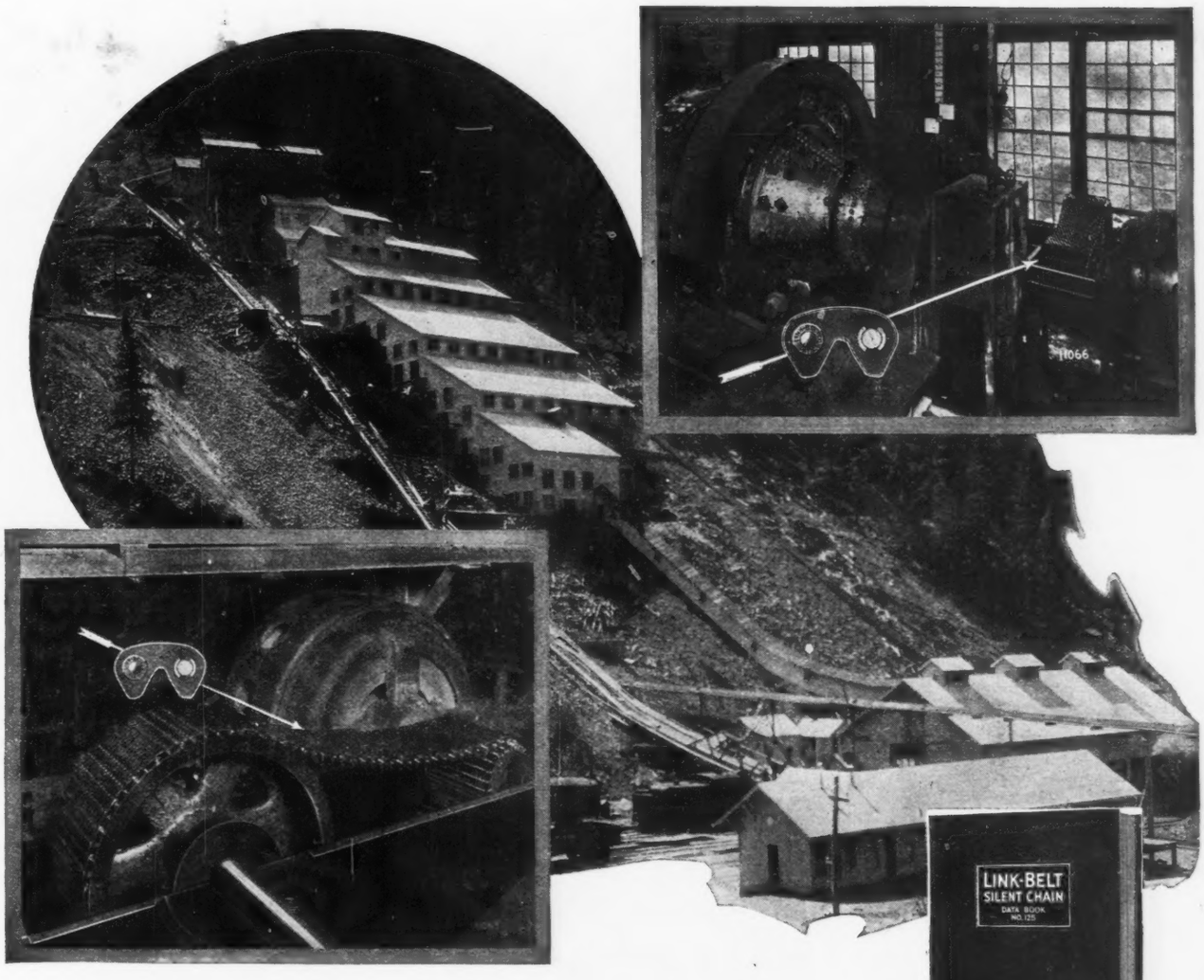
WEDGE ROASTING FURNACES

of various special designs are built for accomplishing two or more operations in the same unit, such as—

—Drying and Preheating
—Drying, Heating and Cooling
—Drying and Desulphurizing
—Preheating and Reducing
—Muffle-heating and Direct-firing
—Partial Desulphurizing for gas production, then Dead-roasting.

Our new Catalog F-1 will explain some of the construction features that make the above combinations possible.

Bethlehem Foundry & Machine Company
Wedge Furnace Department
Bethlehem, Pennsylvania



Efficient Power Transmission

at the Engels Copper Co., Engels, Calif.

Efficient, reliable transmission of power means more than elimination of trouble; it really means increased production. Uninterrupted operation of blowers, grinders and conveyors reflects itself in the output records of the mill.

That's why, after experience with many types of transmission, the Engels Copper Company determined upon using Link-Belt Silent Chain in their mill four years ago.

Send for Data Book No. 125—a handbook on silent chain practice. Return the coupon.

LINK-BELT COMPANY

CHICAGO—300 W. Pershing Road
ST. LOUIS—Central Nat'l Bank Bldg.
DENVER—Lindrooth, Shubart & Co., Boston Bldg.
SAN FRANCISCO—168 Second St.

LINK-BELT COMPANY
910 S. MICHIGAN AVENUE, CHICAGO

Please send postpaid—Link-Belt Silent Chain Data Book No. 125.

Name _____

Firm _____

Street _____

Town _____

State _____

RETURN THIS COUPON

1085

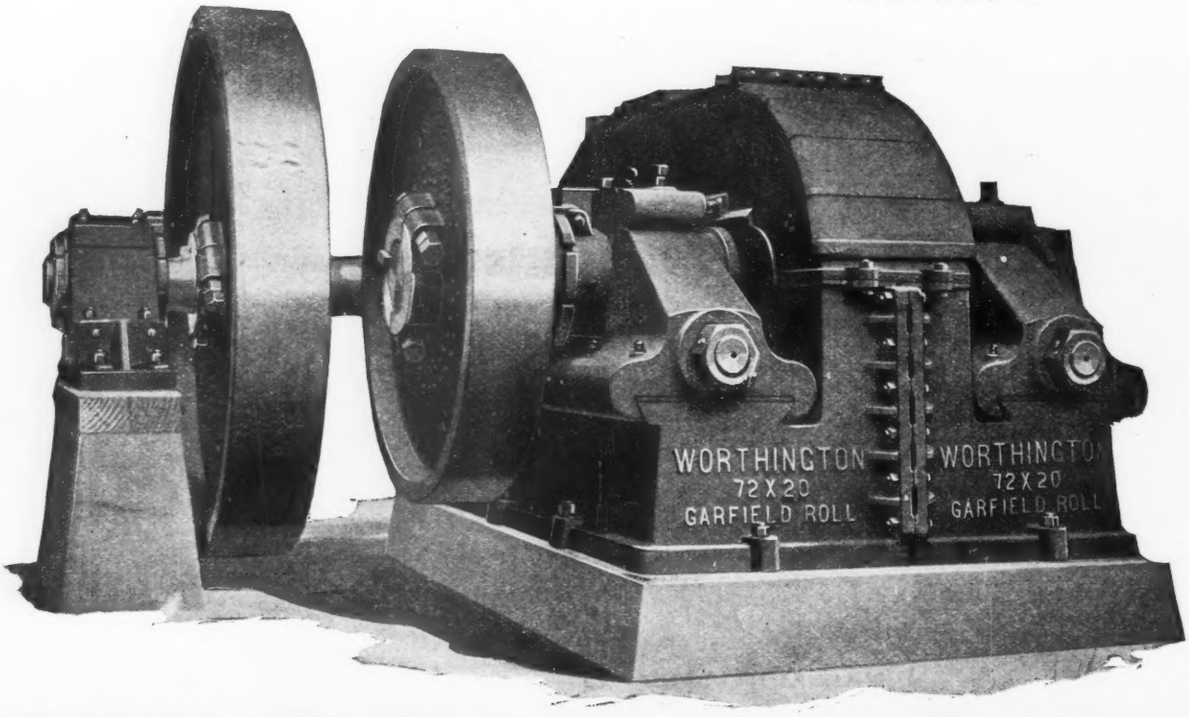
LINK-BELT
SILENT CHAIN DRIVES

They All Have Worthington Garfield Rolls

ALASKA GASTINEAU MINING CO., Thane, Alaska.
AMERICAN ZINC CO. OF TENNESSEE, Mascot, Tenn.
AMERICAN ZINC LEAD & SMELTING CO., Granby, Mo.
BRADEN COPPER CO., Chile, South America.
BUTTE & SUPERIOR MINING CO., Butte, Montana.
CERRO DE PASCO MINING CO., Peru, South America.
CHINO COPPER CO., Hurley, New Mexico.
CHILE EXPLORATION CO., Chile, South America
DUCKTOWN COPPER, SULPHUR & IRON CO., Isabella, Tenn.
FEDERAL MINING & SMELTING CO., Frisco, Idaho.
HECLA MINING CO., Burke, Idaho.
MESABI IRON CO. Babbit, Minn.
NEVADA CONSOLIDATED COPPER CO., Ely, Nevada.
NEVADA PACKARD MINES CO., Nazel, Nevada.
OHIO COPPER MINING CO., Lark, Utah.
RAY CONSOLIDATED COPPER CO., Hayden, Arizona.
SUCCESS MINING CO., Sunset, Idaho.
TIMBER BUTTE MILLING CO., Butte, Montana.
UTAH COPPER CO., Mayma & Arthur Plants, Garfield, Utah.

In every one of the plants listed above the entire roll equipment is Worthington. Evidently the Garfield rolls built at the Worthington Power and Mining Works are regarded with some respect by those who install ore reduction plants.

WORTHINGTON PUMP AND MACHINERY CORPORATION
Executive Offices: 115 Broadway, New York City
Branch Offices in 24 Large Cities



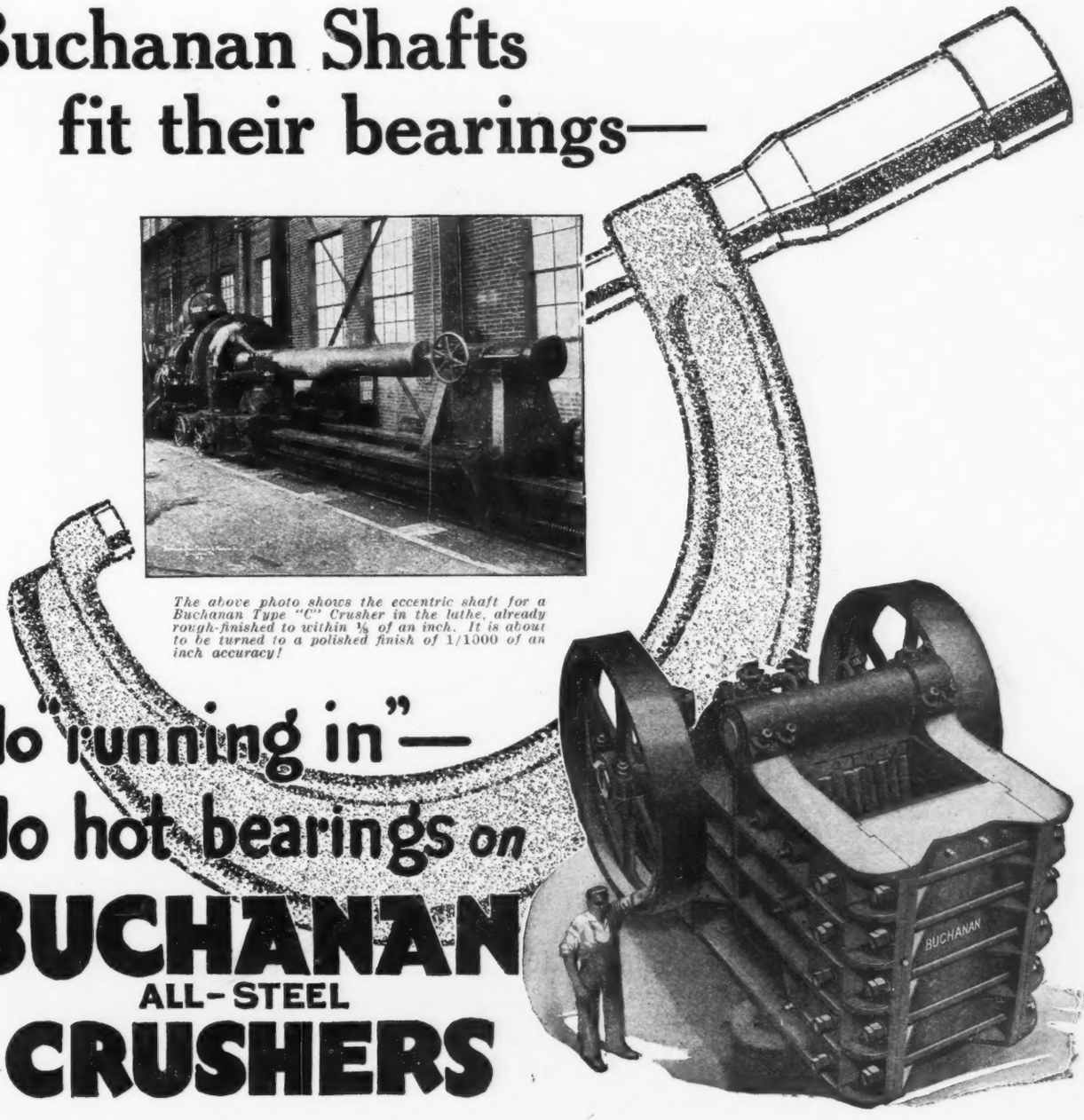
W-195.8

WORTHINGTON

Deane Works, *Holyoke, Mass.*
Blake & Knowles Works *East Cambridge, Mass.*
Worthington Works *Harrison, N. J.*
Laidlaw Works, *Cincinnati, Ohio.*
Hazleton Works, *Hazleton, Pa.*
Gas Engine Works, *Cudahy, Wis.*
Power & Mining Works *Cudahy, Wis.*
Snow-Holly Works *Buffalo, N. Y.*
Epping-Carpenter, *Pittsburgh, Pa.*

Buchanan Shafts fit their bearings—

The above photo shows the eccentric shaft for a Buchanan Type "C" Crusher in the lathe, already rough-finished to within ⅛ of an inch. It is about to be turned to a polished finish of 1/1000 of an inch accuracy!



No "running in"— No hot bearings on BUCHANAN ALL-STEEL CRUSHERS

An ounce of attention to fit and finish *before* the crusher is set up is worth *pounds* of adjustments *afterwards.*

The eccentric shaft in Buchanan Type "C" Crushers never runs hot or tight in the bearings. It is hand-finished and polished *to greater than hairbreadth accuracy.* It FITS the crusher shaft bearings. It continues to fit them even when they are replaced (bearings are readily interchangeable.)

Buchanan Eccentric Shafts are always of large diameters and a long throw of eccentric is always employed. This reduces the pressure per square inch on all bearings, prevents heating, rapid wear, reduces friction and saves on lubricants.

Send for these BULLETINS

Bulletin 10 *fully describes and illustrates Type "C" Crushers; made in sizes up to* 66 *in. x* 84 *in. Bulletin No.* 9*—type "B" Crushers. Bulletin No.* 13*—type "C" Crushing Rolls. Copies of these bulletins promptly upon request.*

C. G. BUCHANAN CO., Inc.
West and Cedar Sts., New York City, N. Y.
Crushers—Crushing Rolls—Complete Crushing Plants

Severing Steel Cables

Every mine operator knows the wisdom of keeping hoisting cables in proper condition.

Resocketing or reclamping at regular intervals is imperative. The simplest, quickest, most effective way of cutting such cables is the Oxweld torch.

The fact that the cutting flame must penetrate so many separate strands makes little difference—in fact, one operator in timing this application of the oxy-acetylene process found it required only two minutes to slice through a cable 2" in diameter!

This wonderful process is pointing the way to greater efficiency wherever metal is used; cutting or welding it is reducing scrap heaps, avoiding costly delays, speeding production.

Oxweld Resident Engineers in more than fifty cities will gladly help with your welding and cutting problems. Write for illustrated book "Oxweld Can Do It".

OXWELD ACETYLENE COMPANY

Newark, N. J. · Chicago · San Francisco

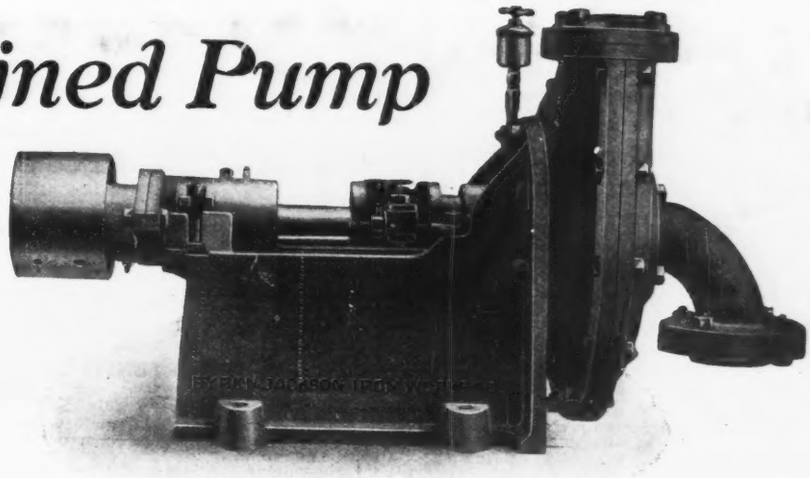
Oxweld

WELDING AND CUTTING APPARATUS

World's Largest Manufacturers of Welding and Cutting Equipment

Rubber Lined Pump

a New Engineering Achievement



After months of experiment and study, the Byron Jackson Iron Works has developed a design of a rubber lined pump, whose wearing parts will have a maximum life when handling abrasive substances.

This pump is adapted to the handling of:

Mill slimes or other material of 15 mesh and finer.

Many chemical solutions which ordinarily attack iron, bronze and other metals, but which have no action on rubber.

Chemical solutions containing more or less grit. These are efficiently elevated with this rubber lined pump.

BYRON JACKSON IRON WORKS - INC.

Wherever water is to be lifted

411 Sharon Building - SAN FRANCISCO

LOS ANGELES VISALIA SALT LAKE CITY PORTLAND, ORE.

SEARCHLIGHT SECTION

EMPLOYMENT-BUSINESS OPPORTUNITIES-EQUIPMENT

UNDISPLAYED—RATE PER WORD:

Positions Wanted, 4 cents a word, minimum 75 cents an insertion, payable in advance.

Positions Vacant and all other classifications, 8 cents a word, minimum charge $2.00.

Proposals, 40 cents a line an insertion.

INFORMATION:

Box Numbers in care of any of our offices count 10 words additional in undisplayed ads.

Discount of 10% if one payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

DISPLAYED—RATE PER INCH:

1 to 3 inches.....$4.50 an inch
4 to 7 inches..... 4.30 an inch
8 to 15 inches..... 4.10 an inch

An advertising inch is measured vertically on one column, 3 columns—30 inches—to a page.

E. & M. J.-P.

POSITIONS VACANT

POSITION open at Nevada silver mine for concentrator man familiar with operation of Deister Plat-O ruffers and slimers. Communicate with 648 Mills Building, San Francisco.

POSITIONS WANTED

FIRST aid organizer and instructor, graduate, United States Bureau of Mines and American Red Cross, 10 years' experience in first aid work, at present with copper corporation as first aid instructor and general office clerk. Desires change to industrial plant or mining corporation where entire time will be occupied with first aid and safety first work. Central American experience. No objection to Mexico, Central or South America. PW-772, Engineering & Mining Journal-Press, Rialto Bldg., San Francisco, Calif.

MINING engineer, 39 years, at present located in Southwest, wide experience in charge of large construction and mining operations, desires change. Power plant design and construction, shovel and underground coal and metal mining, steam and electric railway location, construction and operation. Speaks Spanish. PW-760, Eng. & Min. Jour.-Press, Old Colony Bldg., Chicago, Ill.

MINING engineer, experienced underground surveying, mine and geological mapping, tonnage estimates and general mine engineering. Age 28, married, A.I.M.E. Available on two weeks notice. At present employed. PW-766, Eng. & Min. Journal-Press, Old Colony Bldg., Chicago, Ill.

SWEDISH mining geologist and engineer desires permanent position for prospecting and mine examination in foreign countries. Age 27. Five years' experience in geological and magnetometric surveying. Reply No. 274623, Gumaelius Annonce Bureau, Stockholm, Sweden.

WANT a boss, mining engineer and metallurgist—A long practical training on lead and zinc, its deposition, metallurgy and marketing. A successful record as a producer of results, not an executive, but the right hand of one. Detail of qualifications on request. PW-771, Engineering and Mining Journal-Press, Old Colony Bldg., Chicago, Ill.

Reverberatory management. By one who helped improve the present practice, and now claims to have better improvements than ever. Let me show you my plans. Open for engagement July first. PW-774, Eng. & Min. Journal-Press, Rialto Bldg., San Francisco, Cal.

SALESMAN WANTED

Sales Engineer Wanted

By Pacific Coast manufacturer of mining machinery. Must be sufficiently familiar with established mining and metallurgical practice to be able to recommend apparatus, prepare specifications and estimates, and at the same time to be a competent salesman. Write, giving age, summary of past experience, and salary required. All replies confidential. SW-773, Engineering and Mining Journal-Press, Rialto Bldg., San Francisco, Calif.

BUSINESS OPPORTUNITIES

Quicksilver Mine For Sale

Has been good and profitable producer for many years. Furnace under construction. Old furnace to clean up. Price and terms very reasonable. Address BO-768, Eng. & Min. Journal-Press, Rialto Bldg., San Francisco, Calif.

Mica-Feldspar Mine for Sale

Will sell or lease high grade mica mine. Also feldspar mine producing 65 per cent No. 1 pottery spar. Orders for 3 cars a week with easy possibility of icnrease to a car a day. Both mines operating and selling. Mica is averaging $130 a ton. Less than 5 miles apart; can be operated under one supervision. Blue Ridge Feldspar Co., Asheville, N. C.

Zinc Mine for Sale

Zinc mine, 520 acres, fee title. J. C. Floyd, Yellville, Arkansas.

For Sale—Tungsten Property

(Scheelite). Four full claims (eighty acres), wonderful showings, Nightingale Mining Dist., Pershing County, Nevada. For particular address H. B. Pratt, Fernley, Nevada.

Batopilas, Mexico

30 ft. silver vein, small surface values. Interest for money to sink. References exchanged. Inginiero, El Pino, G. Balderroma, Choix Sinaloa, Mexico.

FOR SALE

GOLD MINE IN NICARAGUA

A large developed Gold Mine in Nicaragua equipped with hydro-electric Power Plant, 80-ton Mill and Cyanide Plant.

PRODUCED $400,000.00
in the last few years

Property contains 40 Claims covering 193 acres.

6 veins from 1,000 to 5,500 feet in length. Veins from a few feet to 30 feet in width.

ATTRACTIVE TERMS FOR QUICK SALE should appeal to promotors and investors.

Address "COTTAM"

700 Tchoupitoulas, New Orleans, La.

A MINERAL COLLECTION WITH EVERY IMPORTANT MINERAL

125 specimens in collection, good size, each specimen with label attached giving name, chemical nature and locality. An ideal collection for a study and display, $28.50 delivered. Booklet of collection gladly sent.

I purchase beautiful and interesting mineral specimens. **GEORGE S. SCOTT**
Canadian Pacific Bldg.
44th St. & Madison Ave., New York City
Room 701

FOR SALE

SILVER MINING PROPERTY

In Austin, Nevada, consisting of approximately 1200 acres, one-half of which are patented. Last owned by Austin-Manhattan Consolidated Mining Co. Includes old mines of the MANHATTAN MINING CO., with record production of over TWENTY MILLION DOLLARS. None of the old mines are deep.

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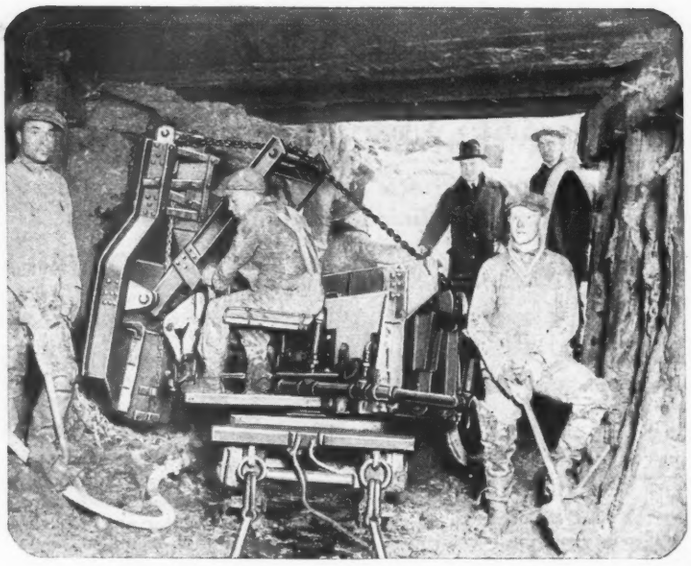

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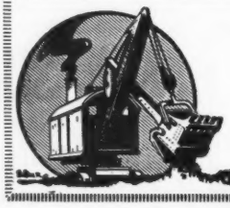

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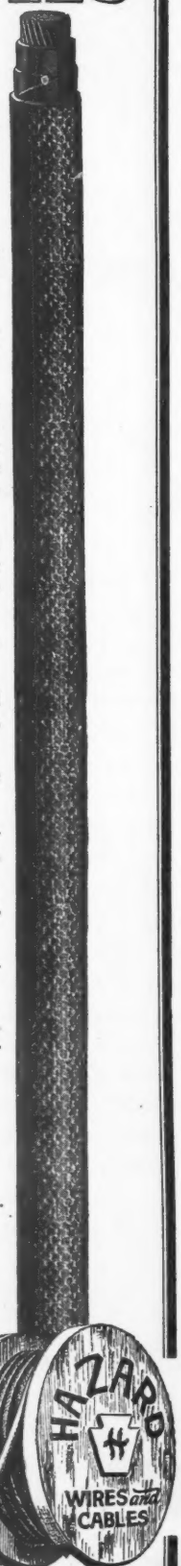

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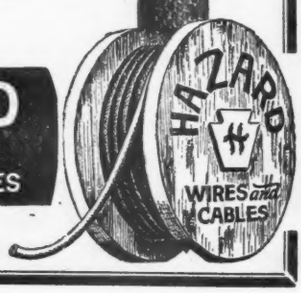

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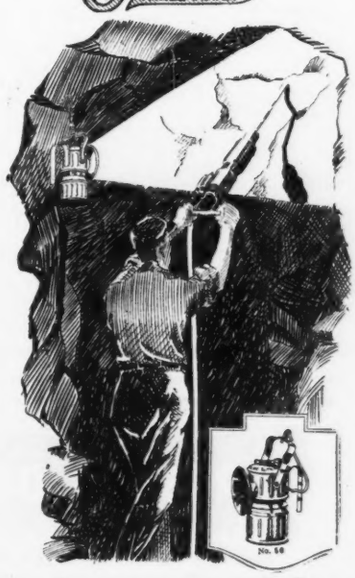

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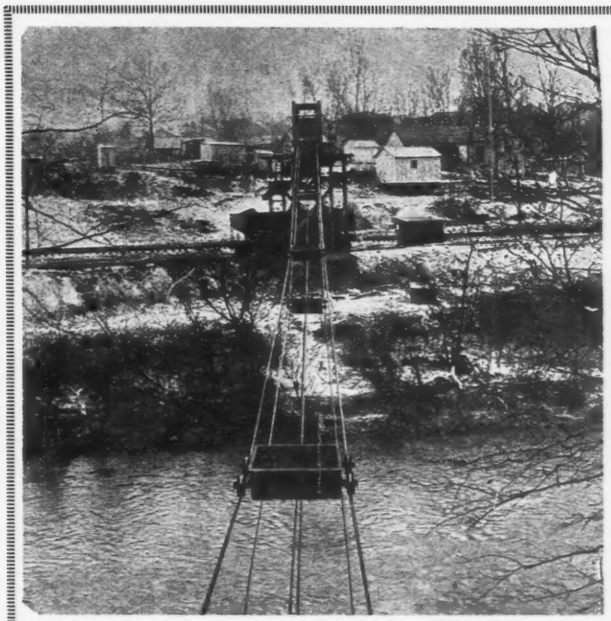

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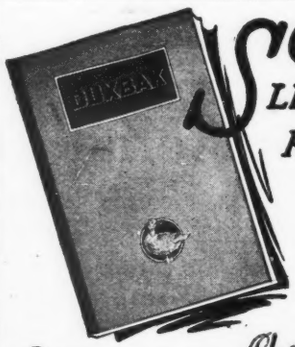

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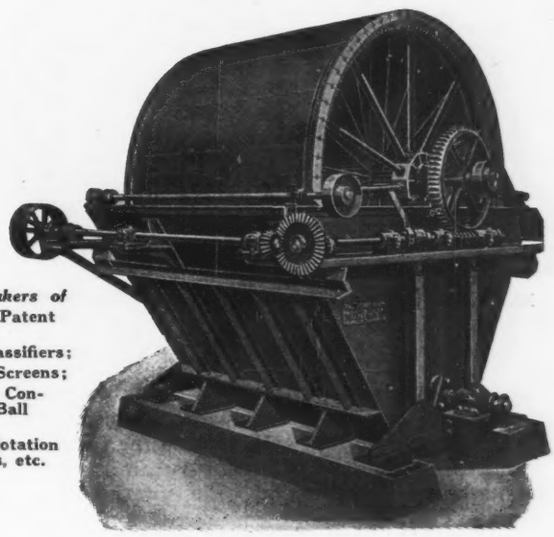

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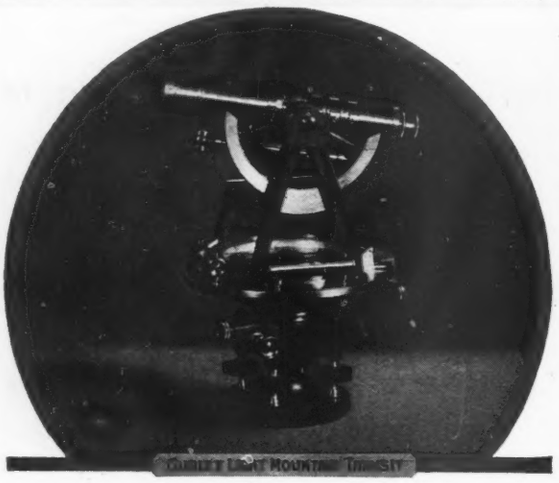

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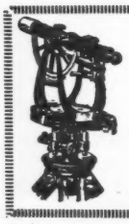

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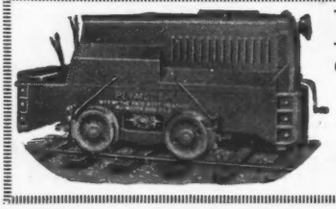

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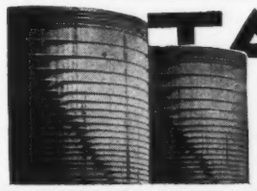

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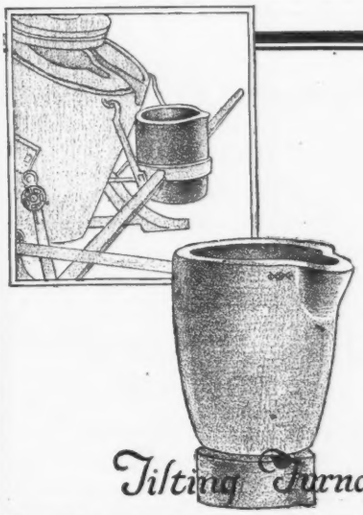

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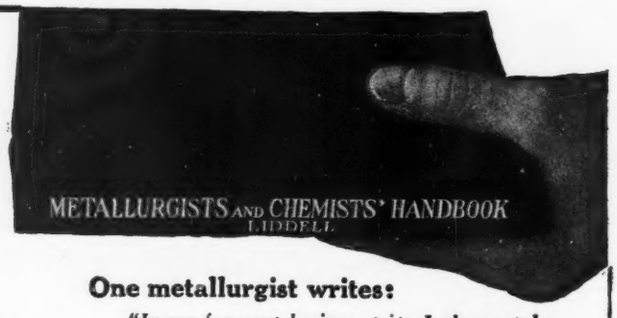

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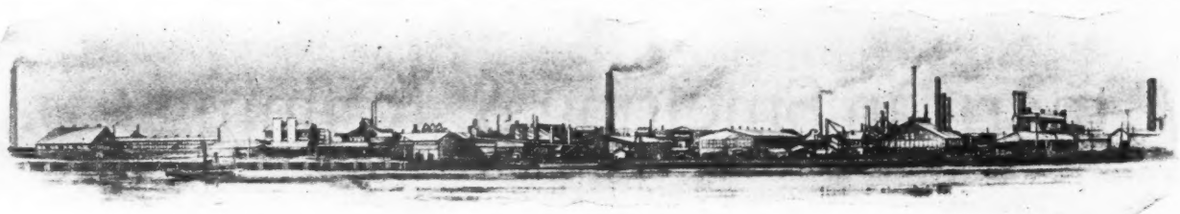

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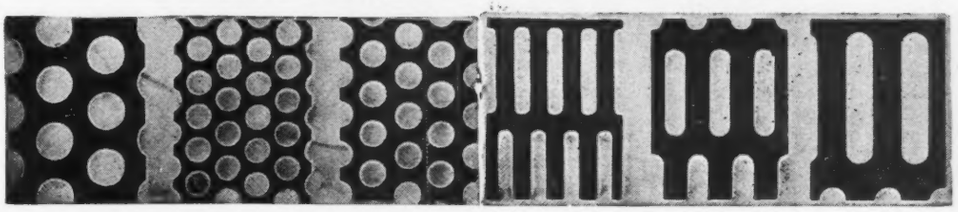

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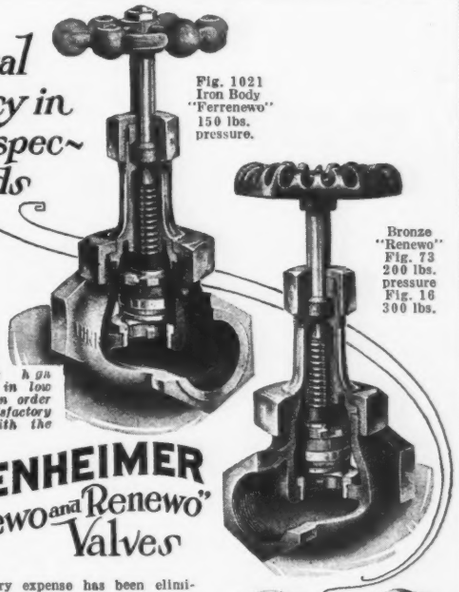

Fig. 1021 Iron Body "Ferrenewo" 150 lbs. pressure.

Bronze "Renewo" Fig. 73 200 lbs. pressure Fig. 16 300 lbs.

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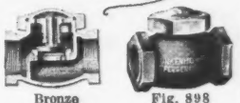

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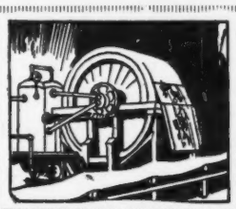

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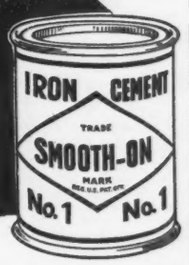

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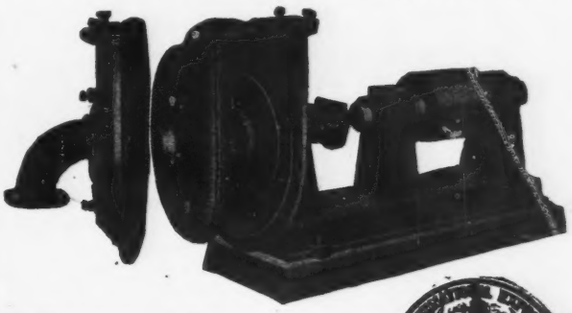

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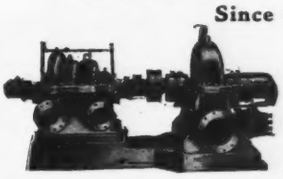

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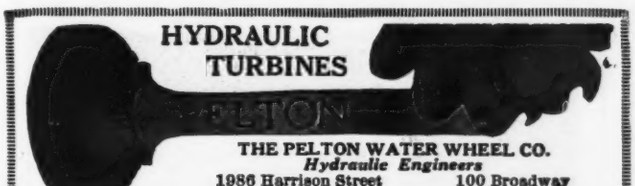

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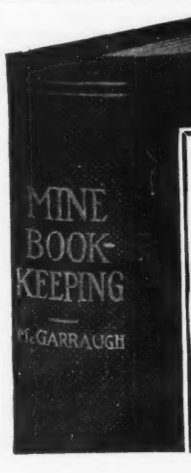

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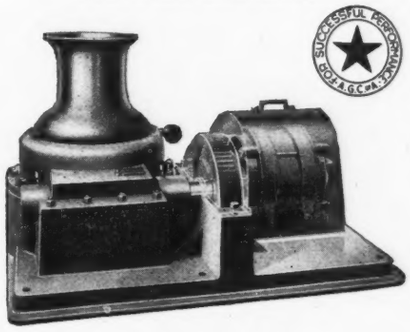

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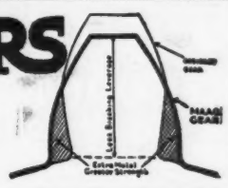

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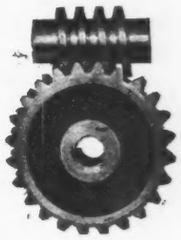

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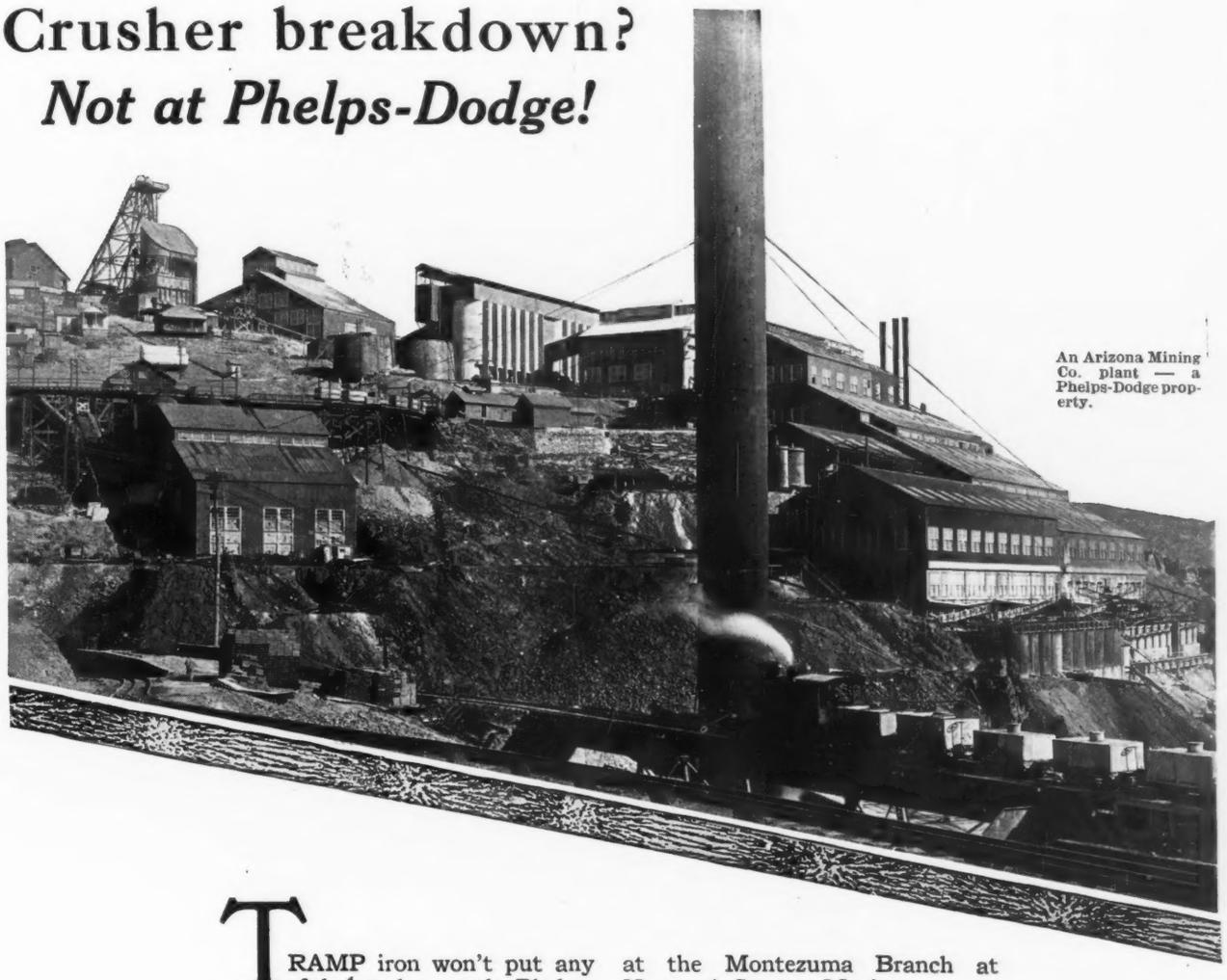

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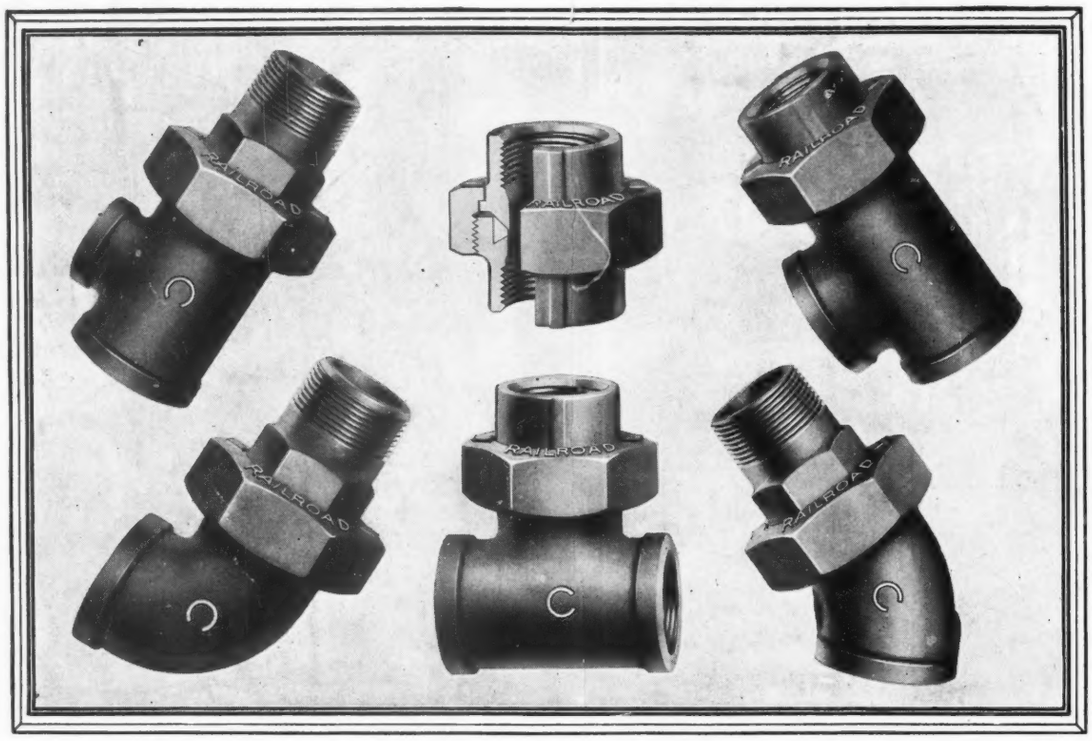

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